COL. JOSEPH H. BRIGHAM.

ASSISTANT SECRETARY OF AGRICULTURE, 1897 TO 1904.

[BORN DECEMBER 12, 1838; DIED JUNE 29, 1904.]

YEARBOOK

OF THE

UNITED STATES

DEPARTMENT OF AGRICULTURE.

1904.

WASHINGTON:
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2

[CHAPTER 23, Stat. at L., 1895.]

[AN ACT providing for the public printing and binding and the distribution of public documents.]

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Section 73, paragraph 2:

The Annual Report of the Secretary of Agriculture shall hereafter be submitted and printed in two parts, as follows: Part One, which shall contain purely business and executive matter which it is necessary for the Secretary to submit to the President and Congress; Part Two, which shall contain such reports from the different Bureaus and Divisions, and such papers prepared by their special agents, accompanied by suitable illustrations, as shall, in the opinion of the Secretary, be specially suited to interest and instruct the farmers of the country, and to include a general report of the operations of the Department for their information. There shall be printed of Part One, one thousand copies for the Senate, two thousand copies for the House, and three thousand copies for the Department of Agriculture; and of Part Two, one hundred and ten thousand copies for the use of the Senate, three hundred and sixty thousand copies for the use of the House of Representatives, and thirty thousand copies for the use of the Department of Agriculture, the illustrations for the same to be executed under the supervision of the Public Printer, in accordance with directions of the Joint Committee on Printing, said illustrations to be subject to the approval of the Secretary of Agriculture; and the title of each of the said parts shall be such as to show that such part is complete in itself.

PREFACE.

The Yearbook is the leading publication of the Department of Agriculture, and the present volume, 1904, presents a large amount of information valuable to the farmers of the country.

As Part II of the Annual Report of the Secretary of Agriculture, its general character is prescribed by the act providing for the public printing and binding, and the distribution of public documents, approved January 4, 1895, which provides that it "shall contain such reports from the different bureaus and divisions and such papers prepared by their special agents, accompanied by suitable illustrations, as shall, in the opinion of the Secretary, be specially suited to interest and instruct the farmers of the country, and to include a general report of the operations of the Department for their information."

Compliance with the above law precludes the possibility of any great variety in the general make-up of the Yearbook, and will explain the Department's inability to consider some of the suggestions occasionally offered with a view to changing its character, even were it deemed advisable to do so.

The present volume includes a general report of the operations of the Department, which feature is supplied by the inclusion of the Secretary's Annual Report, and contains also thirty-one miscellaneous articles, one of which is in three parts by separate authors. These articles cover pretty much every phase of agricultural industry, and include forestry, meteorology, foods, and education. In scope the Yearbook is as broad as the organized work of the Department. It is designed to be practical rather than technical, and to deal with problems of immediate rather than remote concern. It is distinctly a departmental production, only two of the articles referred to being contributed by persons not now in the Government service.

Food law enforcement has made considerable progress in the past year, and a valuable summary of results appears in the Appendix. It is expected that this will be a permanent feature of that portion of the book, to become of increasing importance as time passes and instructive comparisons become possible. The review of game protection this year contains an added feature in a summary statement of the condition of game in the various parts of the country.

The statistics of the principal crops are again accompanied by a few words of explanatory text, which it is believed will add materially to the value of the tables by furnishing suggestions for use in studying them.

Some question seems to exist in the minds of many persons as to the date of issue of the Yearbook, it being apparently assumed by them that the Yearbook for 1904 should have been issued in 1904. It may not be generally understood that the Yearbook is designed to cover the work of the year for which it is issued, and that it deals with the calendar, not the fiscal, year. Hence, it is obviously impossible that it should be completed during the year which it covers. Much of the information it contains, especially that of a statistical character, is not available, as finally revised and verified, until sixty days or more after the close of the calendar year; and while every effort is made to hasten the appearance of the Yearbook, the matter can not be fully prepared and placed in the hands of the Public Printer in its entirety until at least three months after the completion of the calendar year which it covers.

GEO. WM. HILL,
Editor Department of Agriculture.

WASHINGTON, D. C., *April 22, 1905.*

CONTENTS.

ILLUSTRATIONS.

PLATES.

TEXT FIGURES.

YEARBOOK

OF THE

U. S. DEPARTMENT OF AGRICULTURE.

REPORT OF THE SECRETARY.

To the President:

I have the honor to submit herewith my Eighth Annual Report as Secretary of Agriculture.

INTRODUCTORY.

Since my last report progress has been made in securing cooperation with the experiment stations of the several States and Territories; some of the Bureaus of the Department make research in conjunction with all the stations. Preliminary steps have been taken to conduct feeding and breeding experiments in several States looking to the development of breeds of animals suitable to our conditions of climate and soils, and capable of meeting the demands of commerce at home and abroad.

Emergencies arising through the invasion of the cotton-growing States by the boll weevil, a Central American insect that has done much damage in Texas and threatens the entire cotton-growing section of our country, have been met by vigorous work that promises to enable the planters to grow crops in defiance of the pest. The spread over several of the mountain States of a cattle mange required vigorous intervention by the Department. It was necessary to detail a large force of experts to supervise the dipping of the herds in order to eradicate the parasite. Cooperation with most of the States has been arranged, and the rest promise to secure State legislation to compel all flock and herd masters to clean their stock.

The demand in the States for experts to supervise the building of roads suggests the education of engineers in the road laboratory for that work.

The efforts of the Department to create a hardy orange tree that would produce a sweet orange have at last been successful. A hybrid of the Florida orange and Japanese trifoliata has fruited and given us

the desired result. Another hybrid gives us an orange very similar to the grape fruit, and a third gives us a fruit equal to the lemon for all practical purposes. Other fruits of these hybrids will be valuable for marmalades and cooking.

Valuable research has been made in fruit shipping to foreign countries; the value of promptly placing fruit in low temperatures as soon as it is taken from the tree is demonstrated.

The value of nitrogen-fixing bacteria has been thoroughly proved, greatly increasing yields of leguminous plants and the accompanying production of nitrogen in the soil.

Progress is being made in introducing plants that succeed in light rainfall localities.

Importers of foods and drinks are obeying the law with regard to adulterations and false labeling.

The elements of agricultural science are gradually finding their place in the primary and secondary schools, through the instruction of teachers.

We buy over $200,000,000 worth of products from tropical countries that can not be grown in continental United States. Through scientists sent from the United States to the several island groups the Department is instructing the people of our island possessions to grow these things, such as coffee, rubber, fibers, drug plants, nuts, fruits, spices, and the like.

Our farmers buy $100,000,000 worth of machinery every year. A better knowledge of its use and care is necessary. Several agricultural colleges are taking up this inquiry, and giving instruction in regard to machinery and farm buildings.

AGRICULTURE AS A SOURCE OF NATIONAL WEALTH.

Favored with continued prosperity in 1904, the farming element of the people has laid broader, deeper, and more substantial the foundations of a magnificent agriculture. These happy results have augmented the similar ones of 1903, so that a period of some industrial depression during the last two years has been saved by the farmers from the severer conditions that must otherwise have befallen in consequence of the absorption of a large portion of the readily convertible capital of the nonagricultural classes into great and prevalent speculations. Thus it has happened the farms of the nation have been that sustaining power upon which a basic dependence must be placed in all stresses by a people endeavoring to maintain economic self-sufficiency.

WEALTH PRODUCED BY FARMERS.

As great as the financial successes of agriculture were in 1903, hitherto without equal, those of 1904 advanced somewhat beyond them. While some products have fallen behind in value others have more

than filled the deficit, and the general result is that the farmers have produced in value much more wealth than they ever did before in one year.

One conspicuous item that has contributed to this is the corn crop. With a quantity closely approaching 2½ billions of bushels, near the record crop of 1902, the high price of this year gives this crop a farm value much greater than it ever had before, far exceeding a billion dollars. With this crop the farmers could pay the National debt and the interest thereon for one year, and still have enough left to pay the expenses of the National Government for a large fraction of a year. The cotton crop, including seed, became the second one in value in 1903, and remains so in 1904. It is now too early to state even with approximate accuracy what the farm value of this crop is, but indications are that the farm value of lint and seed must reach $600,000,000. In this case, as in the case of all other statements herein made concerning crop values for 1904, it must be borne in mind that the amounts have not been finally determined by the Department, that the figures may be considerably changed when the annual estimate is made in the usual way, and that the values are at the farm, and are not commercial values at the exchange or anywhere else.

Hay and wheat are contending for the third place in point of value, although for many years one or the other has held second place or been next to corn. It is expected that these crops, hay and wheat, will together be worth on the farm this year nearly as much as the corn crop, or appreciably more than one billion dollars. Although the wheat crop has a considerably lower production than in any year since 1900, the farm value per bushel is higher than at any time since 1881, so that this is undoubtedly, by a considerable margin, the most valuable crop of wheat ever raised in this country.

It now seems probable that potatoes and barley reached their highest production in 1904; that the oat crop was never so large by 60,000,000 bushels, except in 1902; and that more rice was produced than in any previous year by toward 300,000,000 pounds, so that the present crop of rice has a commercial estimate of 900,000,000 pounds.

The principal crops that are valued annually by the Department or by commercial houses have an aggregate farm value this year which at the date of this writing apparently amounts to $3,583,339,609. The same crops in 1903, as finally estimated, had a farm value of $3,156,099,392 and had a census value for 1899 of $2,526,345,478. In these principal crops, therefore, the farmers find an increase in value for 1904 of 14 per cent over 1903 and of 42 per cent over the census year five years ago.

On account of the difficulty of estimating the present number and value of farm live stock, it must be sufficient to compare the farm equipment in this respect at the beginning of this calendar year as

determined by this Department with similar statements made for 1903. Farm horses have increased slightly in number and more in value, and in the aggregate they never were so valuable as in 1904, with a total of $1,136,940,298. The value of farm mules also reached its highest point in 1904, $217,532,832. Cattle have declined a little in number and more in value, and the same is true with regard to sheep and hogs; but the steady advance of poultry in number and in the quantity and value of products leads to some astonishing values for 1904 when the census ratios of increase from 1890 to 1900 are extended to the present year. The farmers' hens are now producing 1⅔ billions of dozens of eggs yearly, and these hens during their busy season lay enough eggs in two weeks, at the high prices of eggs that have prevailed during the year, to pay the year's interest on the National debt.

UNTHINKABLE AGGREGATES.

After a laborious and careful estimate of the value of the products of the farm during 1904, made within the census scope, it is safe to place this amount at $4,900,000,000, after excluding the value of farm crops fed to live stock in order to avoid duplication of values. A similar estimate made for 1903 gives $4,480,000,000, and the census total for 1899 is $3,742,000,000. It is by no means to be admitted that these figures represent fully the value of the wealth produced on farms. Within the limits of ascertainable values, the farms of 1904 produced an aggregate wealth with a farm valuation that was 9.65 per cent above the product of 1903, and 31.28 per cent above the figures for the census year 1899.

An occupation that has produced such an unthinkable value as one aggregating nearly $5,000,000,000 within a year may be better measured by some comparisons. All of the gold mines of the entire world have not produced since Columbus discovered America a greater value of gold than the farmers of this country have produced in wealth in two years; this year's product is over six times the amount of the capital stock of all national banks; it comes within three-fourths of a billion dollars of equaling the value of the manufactures of 1900, less the cost of materials used; it is twice the sum of our exports and imports for a year; it is two and a half times the gross earnings from the operations of the railways; it is three and a half times the value of all minerals produced in this country, including coal, iron ore, gold, silver, and quarried stone.

FOREIGN TRADE.

In the exportation of their surplus during the year ending June 30, 1904, the farmers of the country kept well up to the high level of recent years. The average annual value of the exports of farm products during the five years 1899–1903 was $864,930,137, and the value

for 1904 was but little below, or $859,170,582. The year 1904 was exceeded by only two years, 1903 and 1901, in the value of exported farm products.

On the other hand, the imports of farm products for the fiscal year 1904 were higher in value than ever before, this value being $462,384,570, leaving an apparent balance of trade in farm products in favor of this country of $396,786,012, or the lowest balance in these products since 1897. The balance declined $25,495,220 in 1904. This is accounted for on the side of imports mostly by increases in the imports of coffee, wool, tea, cocoa, and chocolate; and on the side of exports it is accounted for principally by a decrease of over $72,000,000 in the value of exported grain and grain products which was not balanced by an increase of about $55,000,000 in the value of exported cotton.

During the last fifteen years the apparent balance of trade in favor of this country, all articles considered, was $4,384,574,143. This was owing entirely to the balance of trade in farm products, which during the same time amounted to $5,202,551,016, and was large enough to leave the above-mentioned balance of trade after sustaining adverse balances in products other than those of the farm, amounting to $817,976,963.

INCREASE OF FARM CAPITAL.

The subject of the achievements and financial condition of the farming population may be pursued farther. While the farmers have been increasing their annual product of wealth since 1899 from great proportions to still greater ones, the value of their farm property has gone on increasing. Ratios of increase from the last three censuses indicate that since 1900 the farm land with improvements, including buildings, have increased in value 1⅗ billions of dollars; the implements and machinery, over $100,000,000; the principal classes of live stock (corrected by the Department's information), $240,000,000. Hence the apparent total of the increase in the value of farms and farm property within four years amounts to about $2,000,000,000, a total that seems to be under the fact, since it does not recognize the marked increase in cotton, corn, wheat, and other lands with high crop values during the last two years. The cotton crop brought to planters not merely an increased price per pound, but it at once made cotton lands more valuable to the extent of several dollars per acre, according to numerous reports received by the Department.

EVIDENCE OF THE BANKS.

The improved financial condition of the farmer is indicated expressively by deposits in banks in several States in which there is so little manufacturing and mining that the conditions are chiefly created by

agriculture. The three agricultural States—Iowa, Kansas, and Mississippi—may be selected for a comparison with the United States as a whole. Individual deposits in the National banks of Iowa increased from June 30, 1896, to October 31, 1904, 137 per cent; Kansas, 212 per cent; Mississippi, 286 per cent; the United States, 92 per cent, or much below the increases of the States named. In the State and private banks deposits during this time increased 128 per cent in Iowa, 227 per cent in Kansas, 306 per cent in Mississippi, and 185 per cent in the United States. In the savings banks of Iowa the increase in deposits was 215 per cent, as compared with 53 per cent for the United States. All kinds of banks being combined, the deposits increased 164 per cent in Iowa, 219 per cent in Kansas, 301 per cent in Mississippi, and 91 per cent in the United States.

A similar comparison favorable to the agricultural States may be made with regard to the number of depositors. In the savings banks of Iowa the number of depositors increased 209 per cent from 1896 to 1904, and in the United States 36 per cent. For National banks, comparison may be made between highly industrial and agricultural States as follows: The number of depositors increased from 1889 to 1903 by 145 per cent in Massachusetts, 117 per cent in New York, 258 per cent in Kansas, and 263 per cent in Mississippi. The increase in Iowa was 184 per cent, the low figure being accounted for by the large development of savings banking.

The Comptroller of the Currency has ascertained the average amount of the daily deposits in National banks, and from his statement it appears that the average daily deposits in October in the National banks of Kansas increased 625 per cent from 1889 to 1903, in Iowa 105 per cent, in Mississippi 89 per cent, in Massachusetts 106 per cent, and in New York 207 per cent.

The farmers' rate of financial progress, as evidenced by the foregoing statements, need fear no comparison with that of any other class of producers. The farmer may not become a millionaire, but he is surer than the millionaire to retain his wealth and to have independence in living.

GENERAL DIFFUSION OF WELL-BEING.

The diffusion of well-being among farmers throughout all parts of the country is one of the most conspicuous features of the recent agricultural development. This attracted attention a year ago and is now even more noticeable; because the great South is more especially enjoying this growth of well-being, owing to the enhanced value of the cotton crop in addition to the general progress in agriculture. The Eastern farmer, who was long on the verge of bankruptcy in competition with the virgin soil and rapid expansion of the northern half of the Mississippi River Valley, has survived that competition and now enjoys more normal conditions, owing

to the creation and maintenance of many large near-by markets by many varied industries. The Pacific Coast has long been prosperous with its world-famed specialties; the mountain States are glad with the fruits and promises of irrigation; in the older prairie States the farmer has seen his land go from $1.25 an acre, or from a homestead gift, to $100 and $150; and the "Great American Desert," as it was called when it was nothing but a buffalo range, is now peopled by a progressive race of farmers, whose banks are filled to overflowing with the proceeds of their products.

WEATHER BUREAU.

OBSERVATORY BUILDINGS.

Carrying out the policy of the Department, the Weather Bureau has continued to cooperate with the leading universities throughout the country, and at the present time the relations existing are more intimate and the work done more important than at any time in the history of the service. Several universities and colleges have donated ground for the erection of buildings. Appreciation of the value of the work being done by the Weather Bureau has also been demonstrated by several universities in placing at the disposal of the Bureau, without cost, office quarters in their buildings for recently established stations. The erection of buildings by the Weather Bureau saves the amount previously paid for rent of office quarters.

FORECASTS.

Weather forecasts for thirty-six and forty-eight hours in advance have been made daily throughout the year for each State and Territory, and special warnings of gales on the seacoasts, Gulf, and Great Lakes, and of cold waves, frost, heavy snows, floods, etc., have been issued when the advices would benefit commercial, agricultural, and business interests. The North Atlantic and West Indian storm-warning service was continued, and forecasts for the first three days out of steamers bound for European ports were issued daily at 8 a. m. and 8 p. m. In a number of instances European shipping interests were notified of the character and probable course of severe storms that were passing eastward from the American coast. Daily warnings and advices issued in connection with the injurious weather conditions of the year resulted in saving much property.

RIVER AND FLOOD SERVICE.

The floods of the year did not approach in character and importance the overflows of the spring of the year immediately preceding, when over 100 human lives were lost, besides property valued at

over $40,000,000. There were, nevertheless, severe floods at various times, and in the management of the work occasioned by them the river and flood service continued to demonstrate its usefulness and growing efficiency as a valuable branch of the Weather Bureau. That there has been constant progress in the accuracy of its work is evidenced by the more specific and detailed character of the forecasts and warnings in localities where such exact work had heretofore been considered practically impossible. The service performed during the prevalence of the great winter ice gorges in the Susquehanna, Allegheny, and Ohio rivers, with their attendant floods, was especially noteworthy. These gorges were the greatest in the history of the localities, and that their great dangers were minimized is due in no small degree to the timely advices and warnings of the Weather Bureau.

There were minor floods during nearly every month of the year, but each was amply covered by timely warnings. These floods were not in any sense alarming or dangerous, but they nevertheless attained sufficient importance to endanger a large amount of property.

CLIMATE AND CROP SERVICE.

The National weather and crop monthly and weekly bulletins and the annual summaries and monthly and weekly bulletins issued from the 43 section centers, also snow and ice bulletins, daily bulletins issued in connection with the corn, wheat, cotton, sugar, rice, and fruit services during the growing season, and the special snow bulletins issued during the winter by the sections in the Rocky Mountain and Plateau regions have appeared regularly during the year and have been of great value in affording timely information.

DISTRIBUTION OF FORECASTS AND SPECIAL WARNINGS.

The extensive distribution of daily forecasts by means of forecast cards has continued, and the railway, telegraph, and train services have supplied in the aggregate over 5,000 railroad stations with bulletins generally posted in the waiting rooms for the benefit of employees and the traveling public. The number of addresses on the rural free-delivery list has been greatly decreased as compared with that of the previous year, owing principally to the discontinuance of the afternoon forecast at some of the centers and the transfer of a large portion of this work to the free telephone service. The rural telephone lines are now the best and most economical means of distributing weather information. The forecasts are quickly disseminated, covering a large territory with little or no expense to the Government. By arrangements made with two of the great trunk telephone lines of Ohio the daily morning forecasts are now available for the use of more than 100,000 subscribers in that State, and the records indicate

that nearly one-half of that number have taken advantage of the opportunity to get the forecasts in their homes within a few minutes after their preparation at the district center.

MOUNT WEATHER METEOROLOGICAL RESEARCH OBSERVATORY.

During the past year the main building of the Mount Weather Observatory has been completed, while the power plant, the building from which balloon ascensions and kite flights are to be made, and the magnetic building are being constructed. The physical laboratory for electrical and radioactive effects is being planned, the erection of which will take place in another year. Finally, a comprehensive physical observatory for photographing the sun directly and through the spectrum, for measuring radiation energy by actinometry and bolometry, with their allied equipment, will be required. This complex institution must grow up slowly as plans can be matured along the best modern lines. When the equipment is ready we shall make and send out apparatus for the exploring of the atmosphere to altitudes of from 3 to 10 miles. It is probable that many balloons will be simultaneously liberated from different stations so as to get records of storms and cold waves from their four quadrants. With observations from the magnetic, the electric, and the solar physics observatories, opportunity for study will be given to those who believe that the cyclonic and anticyclonic whirls that constitute storms and cold waves are mainly the result of changes in the amount or intensity of some form of solar radiation. It is the purpose to make the research at Mount Weather catholic in its broadness.

WIRELESS TELEGRAPHY.

The Department of Agriculture, through the Weather Bureau, was one of the first of the Executive Departments to take up, systematically, experimentation in problems concerned with the development of wireless telegraphy. By this action research into the physical problems concerned in transmitting messages through the medium of ether waves was greatly stimulated in this country. Probably one of the best, if not the best, instruments anywhere made for the receiving of wireless messages had its inception in the experimental work of the Weather Bureau. Recently a board was appointed by you to consider the whole problem of wireless telegraphy and the relation of the Government thereto. Its recommendations, which you approved, will result in the discontinuance of experiments along this line by the Weather Bureau, their transfer to the Navy Department, and the transfer to the Weather Bureau of all the meteorological work now being done by the Navy Department.

LONG-RANGE FORECASTS.

It is hoped the time will come when it will be possible to forecast the weather for coming seasons, to specify in what respect the coming month or season will conform to or depart from the weather that is common to the month or season; but that time has not yet arrived, and the officials of the Weather Bureau have been informed that they will best serve the public interests when they teach the communities they serve the true limitations of weather forecasting.

EDUCATION IN METEOROLOGY.

The Department is interested in the general introduction of meteorology into the courses of study provided by the universities and higher technical institutions of the country. The mode of teaching and the results obtained were made an important part of the work of the Convention of Weather Bureau Officials which was held at Peoria, Ill., in September, 1904. At an increasing number of educational institutions Weather Bureau officials, in addition to their regular duties and mainly outside of office hours, deliver courses of lectures on meteorology.

TELEGRAPH SERVICE.

To meet as far as possible the pressing demands for a wider distribution of the daily telegraphic reports of observations, arrangements were perfected during the year for a very generous increase in the number of such reports telegraphed over circuits and as special messages, and while for economical reasons it is impossible to satisfy all demands in this respect, it is believed that the present distribution of reports will result in a much more comprehensive display of weather conditions on the maps and bulletins and will give general satisfaction both to the public and to our officials charged with making district and local forecasts. Submarine cables have been laid from Block Island, Rhode Island, to the mainland; from South Manitou to North Manitou Island, Michigan; from Flavel, Oreg., across the mouth of the Columbia River to Fort Canby, Wash.; and preparations are being made for laying one from North Nags Head to Manteo, Roanoke Island, North Carolina.

The reorganization at the beginning of the year of the vessel and wreck reporting service of the Weather Bureau, with additional stations at Sand Key, Florida, and Southeast Farallone, California, has largely added to the effectiveness of this popular feature of the Bureau, and is much appreciated by maritime interests generally. Vessel and wreck reports are now furnished free of charge, except for telegraph tolls over commercial lines, to all corporations and individuals who

may apply for them. Besides reporting passing vessels, an important service is rendered by these stations in connection with maritime disasters.

INSTRUMENTAL EQUIPMENT.

The Bureau has now 158 stations completely equipped with instruments by means of which an automatic record is made of the direction and velocity of the wind, the duration of sunshine, the amount and time of beginning and ending of rainfall, and the temperature and pressure of the air. With one or two exceptions the stations that are not at present so equipped are of slight importance, or in general have all the instruments necessary for the satisfactory performance of their work. One hundred and fifty-nine steel towers, with the improved auxiliary equipment for the display of storm warnings, are now installed at as many stations distributed over the shores of the Great Lakes and the Atlantic and Pacific seacoasts. At 77 of these stations high-power electric lanterns are used, and at the others improved oil lights.

BUREAU OF ANIMAL INDUSTRY.

Our animal industry is shown only in small part by the figures giving the exports, yet these exports are so large as to be worthy of notice. The animals exported in the fiscal year 1904 were valued at about $48,000,000, which was an increase over the previous year of $13,000,000; the exports of meat and meat products, including oleo oil, oleomargarin, and lard compounds, amounted to more than $174,000,000, a decrease of $4,000,000 from the year before. We also sent abroad nearly $6,000,000 worth of dairy products, and of other animal products, such as hides and skins, glue, grease, and grease scrap, over $5,000,000 worth. The exact total of the above items of export, as given in preliminary returns, was $223,023,060, which was an increase over the previous year of more than $12,000,000. The Department is fostering this foreign trade, as well as safeguarding the live-stock industry within our own country.

INSPECTION OF ANIMALS FOR EXPORT.

The inspections of live stock for export included Canadian animals that pass through territory of the United States; these numbered about 26,000 cattle and 60,000 sheep. The total inspections for export, including these Canadian animals, were 790,496 for cattle, 534,850 for sheep, and 3,293 for horses. As compared with similar figures for the fiscal year 1903, this statement shows an increase of 43.7 per cent in the number of American cattle exported and an increase of 116.5 per cent in the number of American sheep exported. The number of horses exported, however, was reduced by one-third.

The percentage of loss in transit for the 360,990 head of American cattle landed at the ports of London, Liverpool, and Glasgow was but 0.17; the percentage of loss for the 212,299 American sheep landed at the same ports was 0.94.

The number of clearances of vessels engaged in carrying live stock was 774, and the certificates of inspection issued for American cattle exported to Europe numbered 1,419.

INSPECTION OF IMPORT ANIMALS.

The work of the inspection of import animals calls for the utmost vigilance in order to prevent the introduction of diseases which might prove disastrous to the live stock of this country. Most of the animals that came through the seacoast ports of entry were imported for breeding purposes, but a considerable number of cattle were admitted from Mexico for feeding. The importations of pure-bred animals subject to quarantine were very light during the year, the number at New York, the chief port of entry, having been 266 cattle, 128 sheep, and 123 hogs. The number of farm animals that came through seacoast ports and not subject to quarantine was 2,492; of this total 2,425 were horses. We brought from Great Britain 1,523 horses, from Germany 204, from Belgium 651, and 47 from other countries.

The importations of animals from Mexico were 12,088 cattle, 701 sheep, 314 horses, and various other animals to the number of 203.

An unusually large number of ruminants for menageries, all of which were subject to inspection and quarantine, were imported during the year.

INSPECTION OF MEAT.

The inspection of animals and animal products was maintained at 51 establishments and cities. The total number of ante-mortem inspections was about 65,000,000, whereas in 1903 the number was about 59,000,000; this shows an increase of 6,000,000 animals. The post-mortem inspections amounted to nearly 40,000,000, which was an increase, except as to sheep, over the year 1903. The increase in 1904 in the number of hogs inspected post-mortem was over 2,000,000.

The meat-inspection tag or label was affixed to 22,943,067 quarters and 120,404 pieces of beef, 8,230,528 carcasses of sheep, 765,301 carcasses of calves, 1,122,193 carcasses of hogs, and 726,779 sacks of pork. Besides, the meat-inspection stamp was affixed to 23,000,000 packages of meat and meat products that had received the regular post-mortem inspection.

Compared with the figures of 1903, the statement for 1904 shows an increase in beef exports of 47,138,044 pounds, a decrease in mutton exports of 2,016,924 pounds, and an increase of pork exports of 21,319,830 pounds—a net increase of 66,440,950 pounds for all.

In the matter of the microscopic inspection of pork there was a great decrease, from 19,000,000 pounds in 1893 to 9,000,000 in 1904. This inspection is restricted to the pork that is destined for those countries which require such safeguard. The number of carcasses thus inspected in 1904 was 315,045. The number of carcasses found to be trichinous was 2,643.

The cost of the ordinary inspection was $781,590.95, and the microscopic inspection cost $53,934.01. Each hog carcass cost 17.1 cents for its inspection and each pound of pork exported 0.6 cent.

CATTLE SCAB, OR MANGE.

The existence of scab, or mange, in cattle has for several years past often been brought to the attention of the Department. As early as the spring of 1901 inspectors in the field recognized that scab of cattle was a contagious disease, and asked for instructions regarding it. The disease continued to spread, and during that year numerous inquiries were received as to how the disease could be cured and controlled. It became generally known that the dipping of cattle was the best method of treatment, and the Department received many calls for information as to the construction of vats and the best dips to use. In January, 1902, a bulletin describing scab of cattle and its treatment was issued. There was a large individual demand for this publication and it was supplied to many State authorities for general distribution.

SPREAD OF THE DISEASE.

In spite of efforts to disseminate all the information possible on the subject, the disease spread to an alarming extent, especially on the Western ranges, where the cattle roamed over large areas, and where a few infected animals introduced would communicate the disease to others until the whole band was affected. So extensive was the distribution of the scab that in June, 1903, the Department issued regulations for controlling it, stating that the disease existed among cattle in that part of the United States lying west of the Mississippi River, including the State of Minnesota. These regulations did not apply to the Eastern part of the United States. At that time all of the available funds were used for the employment of inspectors in the Western country in the eradication of scabies among sheep, and there were but a few men who could be used for enforcing the regulations for preventing the spread of scabies among cattle. Many of the Western States, notably Colorado, began during this year to take measures for suppressing the malady within their limits. These States, however, were unable to prevent the disease from being introduced from other States, consequently very urgent appeals were made from State authorities asking that supervision by this Department be extended to cattle scab.

WORK OF NATIONAL GOVERNMENT.

It was apparent that, unless the Federal authorities undertook measures for its control, the States would suffer disaster, not only from the loss of stock affected, but from the embargo which would be placed upon cattle passing from an infected State to one where the disease did not exist. The disease became so prevalent that it was carried from the ranges to the feed lots in States of the Middle West, and there was danger of injury to the trade in live cattle for export to Great Britain. When the scab became so common on the ranges, it was found that unless the cattle were dipped before shipment the cars in which they were loaded became infected; also the stock pens, where the cattle were unloaded for food and rest en route, as well as the stock yards at the leading markets. It became imperative, therefore, that a campaign should be entered upon, and accordingly in March, 1904, regulations were issued applying to all of the United States and prohibiting shipment of cattle affected with this disease from one State to another.

Provision was made in these regulations for allowing shipment after cattle were dipped, and, though affected with the disease, they could be shipped for immediate slaughter after one dipping; but if cattle were intended for feeding or stocking purposes, they must be held for the second dipping, ten or twelve days after the first one. To secure the enforcement of these regulations, it was necessary to station a large number of inspectors in the Western States, particularly the range States where shipments of cattle originated and where the disease was most prevalent. So far as possible the force of inspectors already in this region was used; but this was entirely inadequate to the demands and required an extensive increase, so that at the present time more than two hundred men are in the field engaged in the inspection of sheep and cattle for scabies.

There was an urgent call for inspectors, mostly from persons who had cattle to ship and those who owned affected cattle which required dipping. This dipping in several States was done in cooperation with the State authorities and under the supervision of Federal employees. Shipments of cattle from ranges known to be infected could not be made to market centers without a certificate showing freedom from scabies, or to the effect that the cattle had been dipped and could be transported without spreading the contagion.

During the first nine months of this year, in the 34 States and Territories where this inspection was maintained, 3,843,075 cattle were inspected for scab; 168,203 were found affected with the disease, and 300,275 were found to have been exposed to it. The total number of cattle dipped during this period, under official supervision, was

420,762; 116,362 affected cattle were given one dipping, and 76,974 affected cattle were dipped a second time, after an interval of ten or twelve days. This work necessarily increases the expenses of the Bureau, which, for the month of January, 1904, amounted to $404.65 for this inspection exclusively, and in September, 1904, to $11,770.70.

FOOT ROT AND GID OF SHEEP, AND RABIES.

Besides the several lines of work which have been carried on through a series of years and which have been reported upon from time to time, special work has been done with reference to foot rot of sheep and the disease of sheep commonly known as "gid." In a recent shipment of sheep which arrived at the Buffalo stock yards 75 per cent were found to be affected with foot rot. This disease is not at all uncommon in the sheep-raising parts of the country, and its eradication is not a very difficult undertaking. A bulletin is now in press which deals with all of the phases of foot rot, and should enable the sheep raiser to clean up his flock without much difficulty or great expense.

Although the conditions prevailing in this country are considered unfavorable to the parasite causing gid, the disease, nevertheless, has gained a foothold in the Rocky Mountain States, and it is therefore well to understand the life history of the parasite causing the disease and the methods of dealing with it. It is reported that a few years ago the loss of sheep from gid in France was as great as 1,000,000 annually. This subject has received a thorough investigation, the results of which will soon be published.

Investigations regarding the presence of rabies, or hydrophobia, in the vicinity of Washington, D. C., were continued during the year. Of the 38 suspected cases examined positive results were obtained from 22, of which number 13 were from the District of Columbia.

TUBERCULOSIS.

The work on the subject of tuberculosis has been conducted throughout the year along lines which have been planned for several years. Some experiments which have been recently reported upon by this Bureau go to show conclusively, it is believed, that it is an error to conclude that cattle can not be infected with human tuberculosis. These experiments not only justify but show the desirability of a rigid enforcement of public regulations looking to the control and the eradication of tuberculosis in cattle.

The demand for tuberculin greatly increased during the year. The amount distributed in 1904 was 74,000 doses, while in 1903 the number of doses was 47,000.

DISTRIBUTION OF BLACKLEG VACCINE AND MALLEIN.

The blackleg vaccine for cattle which is manufactured and distributed by the Bureau of Animal Industry continues to give satisfactory results. During the year the number of doses that were sent out fell off somewhat from the report of the previous year, but the number of persons supplied was slightly increased. It is interesting to note that, in 1904, 1,000,000 doses of the vaccine were used and reported upon by over 10,000 persons with highly satisfactory results. After a careful analysis of the figures which were compiled from the reports from the users of blackleg vaccine, and eliminating the deaths which could in no manner be properly charged against the action of the vaccine, the number of cases that died after vaccination is reduced to the very low figure of 0.44 per cent.

The manufacture and distribution of mallein in 1904 for glanders in horses was about the same as in the previous year, and the number of doses sent out was 7,000.

INSPECTION OF DAIRY PRODUCTS.

Under the act of Congress approved May 9, 1902, the Bureau of Animal Industry is charged with the inspection of certain dairy products which are designed for interstate commerce, especially the article of renovated butter. This work is now fully organized and is governed by joint agreement of the Treasury Department and the Department of Agriculture. The reports for 1904 show that there were 73 factories licensed and bonded, which was a reduction of 9 from the previous year. These factories were located in 14 States and the District of Columbia. The quantity of renovated butter made at bonded factories during the fiscal year of 1904 was about 54,000,000 pounds. The average quality of renovated butter is improving. The difference in general character, since the inspection was inaugurated, is very marked. This is due, in part, to improved machinery and processes, and largely to the better average quality and condition of the "packing stock" or raw material used.

Such stock is now closely collected in the producing districts, so that accumulations of country butter at remote points and involving deterioration are not frequent. More care is taken in sorting, packing, and storing the stock. Occasionally a lot of packing stock is found in such a condition of filth or putrefaction as to necessitate condemnation. In still rarer cases the manufactured product is found to be so bad, because of bad materials, ignorance, or negligence in renovating, or as the effect of age, as to make it unfit for food. In a few such instances the sanitary inspection required by law and made by this Department has caused the objectionable materials and products

to be removed from the food market and sold as grease. But, as stated, such instances are not frequent. Although there is still opportunity for great improvement in materials, in the manner of handling and transporting the same, in factory management, and in the finished product, it is true that the manufacturers are endeavoring, as a rule, to improve conditions at all points and are ambitious to win a reputation for producing an article of high quality.

BUREAU OF PLANT INDUSTRY.

In no field of industrial work have there been greater advances during the past decade than in the improvement of plants and the methods of growing them. The Bureau of Plant Industry has done much to bring about these advances. Diseases have been studied and remedies found, new varieties of plants have been created and new industries established, and the world has been searched for better things, all for the purpose of helping the farmer and making his work less burdensome and more profitable.

GROWTH OF THE WORK.

Since the Bureau of Plant Industry was organized, three years ago, the demand for more work has been so great as to require an increase of nearly 50 per cent in men and funds to conduct it. There are now in the Bureau about 500 workers, 60 per cent of whom are engaged in scientific investigation and its application to the farm, the orchard, and the garden. The Bureau is endeavoring to train young men as rapidly as possible for this work. The agricultural colleges furnish a part of these men, but the demand for those with proper qualifications is still greater than the supply.

ENCOURAGING INTEREST IN FARM LIFE.

The Department is not an educational institution in the strict sense of the word, but it can do and is doing much to bring home to the people in all walks of life the importance and value of the farm and its productions. The Bureau of Plant Industry is making a special effort to encourage the study of plants in the public schools. The future welfare of this country depends upon its agricultural development, and it is important and vital that a knowledge of the opportunities in this field should early be brought to the attention of the child. Unfortunately, our system of elementary education is such as to leave no impression on the child's mind of the importance, value, and usefulness of farm life. The child is, in many ways, brought early into contact with facts which point to him the value of commercial life. He is, therefore, early inoculated with the belief that to

reach the highest possibilities he must, if he is on the farm, migrate to the city. It is to be regretted that farm life in the past has not always been conducive to the encouragement of young men to remain on the farm.

Very little effort has been made to overcome the general belief that there is always a great amount of drudgery connected with the farm, and that the opportunities in this sort of occupation are narrow and limited. When we see the rapid advances that are being made in agriculture along all lines and note the need for bright young men in this field, the opportunities offered by the cultivation of the soil seem as great as in any other field. In order to bring these matters clearly home to the children, efforts are being made by the Department to encourage the growing of plants in connection with the public school work. The general distribution of seed is being handled in such a way that the encouragement of plant growing will be a feature of it. Wherever it has been practicable to influence school authorities, this has been done. Various members of the staff of the Bureau are constantly endeavoring by publication of papers, lecturing, etc., to point out the advantages of rural life.

DEVELOPING NEW INDUSTRIES.

RICE PRODUCTION.

The Bureau of Plant Industry has continued its efforts to encourage rice production in the Southern States, especially in Louisiana and Texas. A special farm for the growing of rice has been placed at the disposal of the Department, and upon this farm various questions relating to the industry are being worked out. New varieties of rice are being tested, questions pertaining to the best methods of improving the seed are being settled, and other important problems are under investigation. There has been an enormous increase in the production of rice in the States of Louisiana and Texas during the past three years. As the industry has developed, the necessity has become more and more evident for paying special attention to the improvement of cultural methods.

In the early days of the industry the crop was so profitable that little attempt was made to obtain information on important matters, such as the necessity for rotation, the best methods of handling the water, means of controlling diseases and weed pests, and other important subjects. As competition has become greater and the production larger, farmers are realizing the necessity for paying strict attention to all details connected with the work. Preliminary estimates show that during the year 1904 the area devoted to rice in Louisiana and Texas was 600,000 acres, and the crop will approximate 650,000,000 pounds of rough rice.

DURUM WHEATS.

The success attending the introduction and growing of the durum or macaroni wheats continues unabated. The past season has been a particularly trying one for all wheats in the Northwest. Rust has caused great damage in many localities, but the durum wheats have been in most cases resistant. Probably no less than 14 million bushels of these wheats will be grown the present season, and the evidence at hand indicates that great quantities of the wheats are being saved for seed for next year's planting. Owing to the almost total loss of other wheats east of the area where the durum wheats succeed best, efforts will probably be made next year to plant the durum wheats farther east than they should be planted. It must be remembered that these wheats are specially adapted to semiarid regions, and moving them into humid regions may result in disappointment.

It is gratifying to announce that the durum wheats are now being handled without difficulty by many of the millers, and regular grades corresponding with the grades of other wheats have been established in the markets. From the outlook at present there will be not less than 40 or 50 million bushels of these wheats produced next year. The fact that these wheats are valuable for bread and that they can be grown successfully where most other crops fail is an exceedingly important thing for the agricultural development of the great semiarid West.

THE MATTING INDUSTRY.

The United States imports large quantities of mattings from the Orient. These mattings, for the most part, are made of a species of rush which might easily be grown in this country; in fact, there are already here several native forms which undoubtedly would prove valuable for the manufacture of fine mattings. Special American machinery has been devised and is now in use in the manufacture of a very high grade of mattings. So far, the raw material used by these machines has been imported. During the year the Bureau of Plant Industry has introduced and disseminated considerable quantities of the rush, with the object of securing a sufficient amount to supply American manufacturers with the product. The results accomplished have already proved encouraging, and the work will be continued.

GROWING OF SUGAR-BEET SEED.

The development of the sugar-beet industry continues satisfactory. The Bureau of Plant Industry is making an effort to improve the conditions affecting this crop in the matter of providing better seed, encouraging the use of fertilizers where fertilizers are likely to do good, studying the diseases with a view to discovering remedies for them, securing improvement in the matter of seed by the production of

beets which will give seed balls containing but a single germ. A little more than two years ago the Department again took up the work of establishing sugar-beet seed culture in the United States, and since that time work has been going on in four representative sections of this country. Strains of pedigreed seed are being established in New York, Michigan, Utah, and Washington State, while in Utah and Washington the industry is already assuming commercial importance.

In California also seed is being produced for local use. In Washington State 80,000 pounds of seed were produced in 1904, in Utah about 32,000 pounds, and in California about 50,000 pounds—a total of 162,000 pounds. As rapidly as the Department can bring home to all the sugar-beet factories the conviction that American-grown seed is as good and often better than the imported, these quantities will be increased, and it is a question of but a few years when the entire 5,000,000 pounds used in the United States will be produced at home.

As to the quality, American-grown seed has produced beets testing as high as 24 per cent of sugar, while the average percentage in all beets tested from American-grown seed during 1903 was 15.8 per cent. The average percentage of sugar in all beets grown in the United States, as shown by the factory returns of their total extractions, is a little over 11 per cent. It will be remembered, too, that the American seed has the benefit of only two years of careful selection. The work of establishing a pedigreed strain is slow, and years are required for the completion of such an undertaking; but the work is so far along that its success may be considered assured.

Two years ago the Department imported all the sugar-beet seed that was distributed for experimental purposes, while during the 1904 season 14,000 pounds of American-grown seed were distributed by the Department to selected farmers for testing in comparison with imported seed furnished to them by the factories. The reports on the stand secured, which is generally indicative of the yield, show that the American seed gave almost without exception a greater and a stronger growth than the imported seed. In a number of instances those portions of fields which were sown with factory seed gave such a poor stand that they had either to be resown or abandoned, while the portions sown with American-grown seed gave good stands and in no case required replanting. The factories during 1904 bought 34,500 pounds of American-grown seed, and a number of these factories are now negotiating with the American growers for contracts to supply the seed they need.

SUGAR-BEET FERTILIZERS.

In the fertilizer work efforts have been made to determine the effect of different fertilizers on tonnage and sugar content, and also their influence on various diseases.

Investigations along this line were undertaken in six sugar-beet States, seven brands of complete fertilizers being used, and in addition some separate experiments with the various ingredients used by themselves were made. The preliminary reports which have been received indicate that in many cases the effect of the fertilizers could be seen from the time of the germination of the beets. In a few cases the lines separating the fertilized from the unfertilized plots could be seen even at the beginning of the harvest. A recent report from one of the experimenters states that in his work with nitrate of soda the beets from the untreated plots were worth $5.20 per ton and yielded $54.35 worth of beets per acre. On the adjacent plot, where 300 pounds of nitrate of soda were applied at the time of planting, the beets were worth $5.30 per ton and yielded $74.57, a difference of $20.23 per acre in favor of the fertilization. The untreated beets tested 14.1 per cent sugar, while those fertilized tested 14.4 per cent.

REMEDY FOR SUGAR-BEET DISEASES.

The serious epidemics which have affected the sugar beet, like the leaf-spot disease of the East and the curly top of the West, have been investigated. Experiments on a large scale in different sections of the Eastern beet area have shown that the leaf-spot may be readily controlled by the application of Bordeaux mixture. This remedy has now come into general use.

SINGLE-GERM BEET-SEED BALLS.

In my last report attention was called to the efforts being made in the matter of developing sugar-beet seeds with single germs. The single-germ seed would do much to diminish the labor of thinning. The Bureau work in this field has been very satisfactory. Although the work has been running for only two seasons, decided progress has been made, and the single-germ seeds that have been selected have been found much more vigorous than the multiple-germ balls. The selected strains grown this year show a decided tendency to the production of a larger number of single-germ balls than the parent beet from which the selection was started, the average gain being about 20 per cent. In one case, over 3,000 single-seed balls were found on one beet. The work this year has been conducted in Utah and other sections where the sugar beet is at its best, and indicates that ultimately we shall in all probability be successful in the production of a beet having the desirable quality of producing only balls with single germs, that will substantially save hand thinning and avoid much expense in growing.

NEW CITROUS FRUITS.

The efforts that have been made by the Bureau of Plant Industry for a number of years in the matter of producing, by breeding, new

citrous fruits, so as to build up varied industries in the South, have met with very gratifying results. The hardy sour oranges which have been secured as a result of crossing the sweet orange with the hardy Japanese orange are now ready to distribute, and the work of distribution will be inaugurated in the coming winter. These new hardy oranges will unquestionably make possible the development of several important industries in the South. The oranges are valuable for marmalades, and from the fact that they may be grown in nearly all the Southern States, great possibilities for their usefulness are opened up. Even if they should not come into general use for manufacturing purposes or for general orchard planting, they will undoubtedly eventually become a feature in every dooryard throughout the South. Aside from their value for the manufacture of marmalades and preserves, they will be exceedingly useful for pies and other purposes.

There has been fruited this year for the first time a sweet orange of the hardy type. This is an accomplishment which the Department hoped for when it first inaugurated the work. The other new citrous fruits developed from the Bureau's investigations, such as the new tangelo, which is a cross between the pomelo and the tangerine, two new kid glove, or loose-skinned oranges, and several other creations, will all prove exceedingly valuable in sections where the climatic conditions will permit the growing of these more tender sorts.

AMERICAN TEA.

The Department has continued its work in the production of American tea. The more advanced investigations have been conducted, as heretofore, at Summerville, S. C., in cooperation with Dr. Charles U. Shepard. Doctor Shepard's tea gardens are now yielding from 8,000 to 10,000 pounds of tea annually. Owing to climatic conditions the crop this year will be light. Doctor Shepard has been devoting special attention to the improvement of factory processes. Several new inventions have been made by him in the matter of tea rollers, apparatus for the manufacture of green tea, and apparatus for a process of attrition, giving to the tea the beautiful bluish cast, or finish, which heretofore has been secured in foreign countries by the application of various chemicals.

Doctor Shepard's process puts this finish on the teas by simple attrition or friction, and is a marked advance over the old processes. The work of establishing a plantation in Texas has been continued. Tea beds were started on two types of soil—a rich sandy loam and a black, waxy soil. The plants on the black, waxy land have failed utterly. Fortunately this discovery was made before any extensive plantings had been undertaken, and it will lead to the extension of the plantings on the sandy loam soil. There are now on hand at our Texas station, which is located at Pierce, about 100,000 plants, which

will be put into the field this winter, planting about 40 acres. Sufficient additional seed will be put out to give another 50 acres next year.

AMERICAN DATES.

Encouraging results have been secured in the establishment of this industry in the southwestern portion of the United States. The date orchard at Tempe, Ariz., is progressing in a highly satisfactory way. The work here has been carried on in cooperation with the Arizona experiment station and has been under the direct supervision of Prof. R. H. Forbes. In cooperation with the California experiment station, work on the establishment of date culture in southern California is also being conducted. Ten acres of land have been secured for an experimental orchard and dates have been and are being planted there. The industry has been further encouraged by the publication of important reports on the subject, pointing out available localities where the crop is likely to succeed. There is a considerable extent of territory in southern California where practically all of the dates of a certain class which are now imported could in all probability be grown. These regions have been mapped and a special effort has been made to encourage the production of the crop therein. Various importations of the date have been made during the year and others will follow from time to time as the industry advances.

BULB GROWING.

The very specialized conditions of soil and climate necessary for the proper production of bulbs and the peculiar nature of the skilled labor required have made the establishment of the bulb industry difficult. However, investigations have shown that nearly all of the so-called Dutch bulbs may be grown in the United States, and that one by one the difficulties due to competition of cheap skilled labor, excessive cost of transportation, and the natural hesitancy on the part of purchasers to use an untried article will be overcome. A method has also been discovered by the Department experts to produce the Bermuda lily bulb free from disease. Of the millions of lily bulbs annually imported, it is safe to say that 40 per cent are more or less affected by disease. The eventual elimination of this trouble will be due to the work of the Department.

AMERICAN-GROWN DRUG PLANTS.

In Vermont, the previous success in growing opium poppies has been repeated with even more satisfactory results, both the white-seeded and blue-seeded sorts giving good crops. The attempt to cultivate this plant has been made with the object in view of testing the possibility of developing in this country a means of supplying our demand

for poppy alkaloids for medicinal uses. The present source of these—morphine, codeine, etc.—is to be found in crude opium, of which approximately a million dollars' worth is imported annually. The cost of these products is in large part due to the labor involved, and the efforts of the Bureau have been directed toward devising some process whereby the alkaloidal principles can be isolated directly from the extracted juices of the plant. Up to the present time no one has succeeded in obtaining morphine from these extracts.

During the year an expert of the Bureau has, however, met with success, and we are now able to obtain morphine directly from the expressed juices of the plant. This method does away with much of the expense. Experiments are now being undertaken to ascertain the practicability of obtaining morphine directly from the plants as a commercial source. If the experiment indicates a favorable outcome the plants produced in American fields will replace oriental opium as a crude source for morphine.

SWEDISH SELECT OAT.

The experiments of the Department with this hardy Swedish oat ceased some time ago, but highly interesting reports in regard to its usefulness are still coming in. It was introduced about five years ago by the Bureau of Plant Industry and distributed in a number of the Northwestern States. It has high qualities as a yielder and is especially valuable for resisting drought.

It has now become the most popular variety in the States of Wisconsin, North Dakota, Montana, portions of Idaho, South Dakota, and Minnesota. In one instance in Wisconsin, from the planting of 33 grains in the spring of 1899, there resulted a production of about 20,000 bushels in the year 1903, and a half million bushels in the present year, 1904. It is expected that the present year's crop will show that about 4 million bushels of this oat are being produced in Wisconsin. Although the highest legal weight of oats is 36 pounds to the bushel, this variety commonly weighs from 40 to 44 pounds in the Northern States, and occasionally reaches from 48 to 50 pounds to the bushel.

SPECIAL WORK ON COTTON.

The Bureau of Plant Industry has made a special effort to aid the farmers of Texas, Louisiana, and other Southern States where the Mexican cotton boll weevil has already appeared or is likely to appear. In all sections the energies of the Bureau have been put forth to encourage better methods of farming, with highly gratifying results.

COOPERATION WITH FARMERS.

With a view to bringing directly home to the farmers of Texas and Louisiana, especially those in the boll-weevil districts, the advantagse

of better methods of cultivation, the value of early maturing seed, etc., the Bureau organized an extensive line of propaganda work. The farmers in the various counties were organized and were brought into cooperation in such a way that large plantings were made under the direct supervision of the Department. Tracts of 5, 10, 15, and 20 acres were handled by individual farmers, under working plans furnished by the Bureau, the object being in all cases to demonstrate the practicability of growing cotton despite the presence of the weevil.

More than 5,000 farmers were engaged in this work, and the results have been highly satisfactory. At a recent meeting held in Houston, where more than 200 representative farmers from all parts of the State were present, records were presented showing the yields of cotton under the plans of the Department compared with old methods. The increased yields, ranging all the way from 25 per cent to 100 per cent in districts badly infested by the weevil, show that by proper methods of culture, the use of early maturing varieties of seed, and the application of proper fertilizers excellent results may be obtained. A complete record of the yields from the various farms conducted under the direction of the Bureau has been kept, and a report embodying these data will soon be published.

COOPERATION WITH THE TEXAS AGRICULTURAL COLLEGE.

In the special work on cotton the Bureau of Plant Industry has been in the closest cooperation with the Texas Agricultural College. The president of the college has taken charge of the farmers' institute work, and with the aid of several men selected by him and men furnished by the Department all parts of the State were visited early in the spring, and the necessity for giving strict attention to better methods of cultivation was set forth. This institute work will be continued during the present autumn and winter. In addition to the institute work, the Bureau has been cooperating with the college in the matter of the breeding of cotton, the testing of fertilizers, and other important lines of investigation. Thorough harmony prevails, and every effort is being made by both the Department and college officials to make the work effective.

COOPERATION WITH LOUISIANA AUTHORITIES.

Cooperation has also been secured with the Louisiana authorities, and a number of important lines of work have been carried on in the State. The propaganda work, as described for Texas, has also been conducted in portions of Louisiana. Demonstration work with fertilizers has been carried on; also other investigations having for their object the encouragement in every way of better methods of farming in advance of the approach of the weevil.

DIVERSIFICATION FARMS.

As another feature of the work in the South, plans were made and put into operation establishing diversification farms at various places. The object of these farms was to show the value and importance of diversified agriculture. It was found unnecessary for the Bureau to expend any funds in the development of these farms, except in minor ways for the purchase of certain special seeds, and sometimes for special fertilizers where such were to be used. In all cases the business interests of the respective communities gladly cooperated with the Bureau to the end not only of securing a desirable farm for the purpose, but assuming all responsibility for its support. In every instance efforts have been made in organizing these farms to make them not only self-supporting but profitable. The main object of the work is to show that by diversified agriculture the lands may not only be improved, but more money can be made than in farming with a single crop.

Thirty-two of these farms have been or are about to be established, of which 16 are in Texas, 5 in Louisiana, 3 in Georgia, 2 in Alabama, 3 in Mississippi, 2 in South Carolina, and 1 in Florida. The general method employed in locating, organizing, and conducting these farms is to first determine in what section of the State the various farms are to be located. An effort is then made to find a progressive farmer who is desirous of encouraging diversified farming in his section, and who is willing to permit the Department to aid him in doing it. When a suitable arrangement has been made, a representative of the Department and the State experiment station make a thorough study of local conditions with reference to cropping possibilities, markets, advantages, etc. A system of records is instituted, which enables the Department to secure detailed information regarding every phase of the management of the farm and the results secured. After the farms are established, other farmers are encouraged to visit them, this being done largely through the cooperation of the State experiment stations.

BREEDING NEW TYPES OF COTTON.

Extensive work has been inaugurated in Texas having for its object the breeding of new types of cotton better adapted to meeting the conditions brought about by the invasion of the weevil. More than 100 varieties of cotton have been grown and many selections have been made. This is necessarily slow work, but already very encouraging results have been secured in the matter of obtaining earlier and better yielding types—types that are better able to resist storms and types for special purposes in several regions.

DISCOVERY OF THE GUATEMALAN ANT.

During the year an important discovery was made by an officer of this Bureau, viz, the discovery in Guatemala of an ant that destroys the weevil. Eighty-nine colonies of these ants were brought into Texas and are now being thoroughly studied with a view to determining their value as a means of checking the serious inroads of the cotton insect. After the introduction of the ant by this Bureau further work on its distribution, habits, etc., was placed under the Bureau of Entomology.

WEEVIL-RESISTANT COTTON.

Another and perhaps more efficient method of combating the boll weevil than by means of the ant has been discovered very recently. The hope of finding a variety of cotton not subject to injury by this pest has been cherished for several years, but hitherto no method has been ascertained by which the plant could offer effective resistance to the insect. It has been found, however, that in some varieties of cotton the presence of the larva, instead of blasting the buds and bolls, often stimulates a special growth of internal tissue which kills the young weevil. This is not merely accidental or abnormal, but is in the nature of a protective adaptation developed as a final result of a long struggle for existence between the cotton and the weevil in tropical America. The insect could not breed or perpetuate itself in the presence of a variety of cotton in which the formation of the new protective tissue occurred regularly. It is accordingly within the range of scientific possibilities that resistant varieties of cotton can be found in tropical America or developed by selection, and work on this line has been begun.

DISTRIBUTION OF EARLY-MATURING VARIETIES OF COTTON SEED.

With a view to encouraging the planting of early-maturing varieties of cotton, such as King and Parker, a large distribution of these varieties was made in the State of Texas and a portion of Louisiana during the year. Small quantities were sent to farmers, the cooperation of Senators and Members of Congress being secured for the purpose of distribution. Records have been kept of all the farmers who received this seed, and reports are now being returned to the Department as to its value as compared with ordinary sorts. In most cases very encouraging reports have been received as to the use of the early-maturing seeds, and the chief value of the work will be in the fact that from this distribution the farmers themselves may start the selection of stock seed for future planting.

INVESTIGATION OF THE COTTON ROOT-ROT.

As a feature of the work in Texas a special effort has been made to obtain information as to the best methods of combating the cotton root-rot. This disease has been very serious the past season, destroying large areas of cotton in many portions of the State. Efforts have been made to secure resistant types, but so far the results obtained have not been very encouraging, although some progress has been made. Experiments have been made for the purpose of determining the value of soil treatments, seed treatments, and other methods of combating this disease, including crop rotation. This work has just been started, and it is too early yet to determine its value.

PROGRESS IN COMBATING PLANT DISEASES.

CRANBERRY DISEASES.

Important advances were made during the year in the matter of treating cranberry diseases. The cranberry crop is an important one in this country, aggregating in value a million dollars or more annually. In recent years several destructive diseases have caused a great deal of damage, and until the Department began its investigations little progress had been made in the matter of treatment. Experiments the past year in the treatment of one of the most serious diseases, commonly known as "scald," have been quite successful. It has been demonstrated that this particular disease may be prevented by the application of fungicides at very small expense.

ERADICATION OF LITTLE-PEACH DISEASE.

The efforts made by the Department in the matter of demonstrating the feasibility of eradicating the little-peach disease from the orchards of Michigan and other States have been continued on a large scale. A section 3 miles square in Michigan was selected for this work and the orchards were thoroughly gone over three times during the months of July, August, and September and all of the affected trees were destroyed. The object of this experiment is to demonstrate what is believed to be a fact, viz, that the disease can be entirely eradicated by the extirpation process.

WINTERKILLING OF FRUIT TREES.

The extreme cold of the past winter caused the extensive killing of fruit trees in many portions of the Northern States. At the approach of spring the trees had the appearance of being seriously injured, and undoubtedly a great many would have been destroyed but for the timely aid rendered by the Department in the matter of suggesting proper means of handling such injuries. A brief report was issued as a guide to the owners of the frozen trees, and this undoubtedly saved many orchards from needless destruction.

A NEW DISEASE OF TOBACCO.

The most serious disease of tobacco in the United States during the past season has been the new malady called "wilt." This has been very destructive in certain portions of the South, and so rapid has been the spread of the trouble that it threatens the complete destruction of the large tobacco industry in North Carolina. Evidence is at hand that this disease is very similar to other wilt troubles, and that it may eventually succumb to treatment through the selection and development of resistant types. Work with a view to securing these types is now being conducted.

WILT DISEASE OF COTTON AND COWPEAS.

The success of this Bureau's wilt-resistant varieties of cotton was more marked last season than ever before. An improved selection from the Rivers cotton remained entirely free from the wilt on the worst infected land on James Island, South Carolina, where the finer types of Sea Island cotton are grown. These cottons, originating through the efforts of the Department, are not only wilt resistant but have a finer and better staple than the original nonresistant strains, thus disproving the assertion that resistance to wilt had been obtained at the sacrifice of quality. Considerable quantities of the seed of resistant and desirable strains of cotton have been obtained and distributed. In connection with this work the wilt of the cowpea has also been studied and resistant types secured and distributed. About 200 bushels of the resistant cowpea seed were sent out last spring. This work is being developed as an auxiliary to the cotton investigations, as it has been found that many thousands of acres of sandy soil in the Gulf States are infected by both the wilt and root-knot, and the cultivation of the ordinary cowpea results in great injury to the cotton.

ADVANCES MADE IN FORAGE-CROP WORK.

ALFALFAS AND CLOVERS.

Alfalfa has attracted more attention on the part of farmers in the eastern half of the United States during the past two years than any other crop. The Department has demonstrated that it can be grown in almost every State in the Union. Varieties have been found which withstand the rigorous winters of the northwestern prairie States. Other varieties have been found which are immune to the alfalfa leaf rust. There is still much to be learned concerning the adaptability of alfalfa to various types of soil in the Eastern States, and much time is being devoted to the solution of this problem. The cultural methods required for establishing and maintaining alfalfa meadows are also receiving due attention. The subject of clover sickness, a matter of very great importance to farmers throughout the clover region, is

being investigated. New varieties of clover which appear to possess some advantages over the standard varieties grown in this country have been secured and are being propagated with a view to introducing them generally in the clover region as soon as sufficient seed is available. Some of our native clovers are being grown under farm conditions in order to determine whether or not they are worthy of domestication. One or two of them are promising, particularly for sections of the country where red clover does not thrive.

SOIL AND SAND BINDERS.

Methods of holding drifting sand in place have been thoroughly worked out. An agent of the Department has made a careful study during the past two years of the methods which have been developed in Europe in work of this character, and demonstrations of these methods are now being made in portions of the country where drifting sand is most troublesome. Attention is also being given to plants adapted to hold banks and the sides of cuttings in place, and several plants which possess high value for this purpose have been found. This work is of particular interest to civil engineers, and in prosecuting it the most hearty cooperation from them has been received.

RANGE INVESTIGATIONS.

During the past year a large amount of information regarding the carrying capacity of the ranges in various parts of the West has been collected. The fact that intelligent management will bring the ranges back to their primitive state of productiveness has been established. For two years past an area of fenced range in Arizona, in which all types of range land are represented, from absolute desert to good mountain range, has been under careful observation. Two years' protection from stock has sufficed to make this range nearly as productive as it was in its virgin state. The methods of management used by parties who own or control considerable areas of range land are being studied. It is considered to be definitely demonstrated that there is no chance of improving range conditions except where stockmen are enabled to control the ranges upon which their stock feed, and data are being collected which will furnish valuable information as a basis for legislation concerning range lands. It has been demonstrated that a number of species of plants may be introduced upon the ranges by practicable means.

In nearly all cases the plants which have been of value for this purpose are annuals producing large quantities of seed. The possibility of introducing other plants upon the range is still being investigated. In this connection a careful study of the large collection of annual grasses from Europe in our extensive herbarium is being made, with a view to finding species which appear to be adapted to conditions on

our Western ranges. Arrangements have been made whereby seed of some of the most promising of the species may be secured for use in the investigations of this subject. It has been demonstrated that in the mountain ranges where there is considerable rainfall a number of standard grasses and clovers may be established upon the range by methods that are entirely practicable. In the mountain region in the State of Washington, by protecting the range from the depredations of nomadic herds of stock, the Bureau has been able to establish such grasses as timothy, redtop, bluegrass, and white clover, thus adding enormously to the productive capacity of these ranges. During the year much assistance has been rendered to ranchers by outlining methods of handling their ranches.

THE CACTUS AS A FORAGE PLANT.

Much of the range country is covered with a sparse growth of cactus, which for the most part is looked upon by stockmen as a nuisance. During the past year a number of methods have been found by which the cactus plant may be utilized to advantage as stock feed. The value of the more promising species for forage purposes, the length of time required to mature a crop of cactus on land from which the old growth has been harvested, and the feasibility of establishing cactus plantations where they may be needed, are now being investigated.

ALKALI-LOVING PLANTS.

The increase of the area of alkali lands in the irrigated districts of the West has given added importance to plants that may be grown upon such lands. Several such plants are available, and the Bureau is investigating the forage value of these plants, as well as methods required for their cultivation. A few years ago the Australian saltbush was shown to be adapted to lands of this character, and a great deal of interest in this plant was aroused among Western farmers. Recent investigations by the Bureau indicate that the cultivation of the plant has practically ceased. There is no question of the value of the Australian saltbush as a forage plant or of its adaptability to strong alkali lands. The principal difficulty with the plant seems to be that proper methods of utilizing it have not been worked out. The Bureau has undertaken to find what place it can be made to occupy in Western agriculture and the methods by which farmers can take advantage of its demonstrated value. Considerable areas of a number of other forage plants known to be adapted to alkaline conditions are being grown with a view to determining their forage value.

INVESTIGATIONS OF GRASSES, FORAGE PLANTS, AND STOCK FEEDING.

The office of Grass and Forage Plant Investigations is now in possession of the varieties of timothy developed by Dr. A. D. Hopkins. Some of these are greatly superior to timothy as ordinarily grown by farm-

ers. They are being propagated with a view to making the seed available, which it is hoped will be within two more years.

Mr. A. B. Leckenby, director of the Eastern Oregon experiment station, has kindly turned over to this office 23 varieties of *Bromus inermis* secured by him during the past two years. These are being grown with a view to rendering the best varieties available for distribution.

The separation into varieties of such standard grasses as redtop, Bermuda, orchard grass, and meadow fescue has been undertaken. Work of this character already done indicates that all of our standard grasses are really mixtures of a large number of established varieties. Some of these varieties are much superior to the grasses ordinarily grown. It is hoped within a few years to be able to offer farmers small quantities of seed of improved forms of all the standard grasses.

WEIGHT AND VOLUME OF HAY.

The office of Grass and Forage Plant Investigation has shown that the ordinary rules in vogue for determining the volume of hay in the stack are not reliable, and it has developed formulæ that give reliable results. It is now investigating the number of cubic feet of hay per ton for hay under various conditions as to kind of hay, size of stack, and length of time it has been in stack.

DOMESTICATING NATIVE GRASSES.

A considerable number of native American grasses have shown themselves to be adapted to regions where at present hay grasses are wanting. Several of these are being grown under field conditions during the present season with promise of success. The Bureau is gathering a considerable quantity of seed of other grasses this year and will give them a trial, particularly in the semiarid portions of the West, at the earliest opportunity. It is believed that hay grasses can be found for the Western plains where the average annual rainfall does not exceed 15 inches.

WINTER PASTURES FOR THE SOUTH.

It is estimated that during the past winter one-third of the range stock of some of the ranges in Florida perished for lack of proper nourishment. The winter being severe, losses of range stock were common in all parts of the South. It has been demonstrated that a number of plants can be made to furnish satisfactory pasture throughout the winter months in the South. During the past year a large amount of information concerning these plants and their adaptability to different soils, and the cultural methods required for their successful growth, has been collected. During the present season it is planned to cooperate with Southern experiment stations and Southern farmers in testing a number of these plants for winter pasture purposes.

GULF COAST CROPS.

The agrostologists of the Bureau are studying the forage value of the velvet bean, beggar weed, Mexican clover, and cassava for the region adjacent to the Gulf of Mexico, to which our standard forage crops are not adapted. They have shown that a well-nigh perfect stand of cassava can be obtained by germinating the canes in a cold frame or hotbed before planting them in the field. Heretofore the methods used produced ordinarily not more than half a stand of this crop. Methods of keeping cassava canes over winter are still being investigated. These investigations indicate that the most important factor in keeping the canes is maturity. It is extremely difficult to prevent decay of partially matured canes during the winter months. Forty-two varieties of cassava have been secured, one of which last year produced seed in southern Mississippi, although planted nearly two months later than the best planting season. This year one plant was grown from this seed. It seems probable that some of these varieties may be made to thrive considerably farther north than cassava has yet been grown.

FORAGE CROPS FOR SOUTHERN FLORIDA.

The development of truck farming in southern Florida has rendered urgent the need of forage crops for the work-stock used on the truck farms and for the dairy cattle which supply milk to the numerous hotels. Feed for this stock is now shipped long distances at great expense. It appears that Guinea grass and Para grass are adapted to climatic and soil conditions in that section and their possibilities for this purpose are being investigated. Guinea grass seems to possess particular value for hay production, while Para grass appears to be promising as a pasture grass, particularly for wet muck soils. The Bureau is preparing to give them an extended trial.

PACIFIC COAST PROBLEMS.

The office of Grass and Forage Plant Investigations is searching for forage crops to grow in alternation with wheat in order that farmers in the great wheat regions on the Pacific coast may be enabled to secure more than one crop every other year on their fertile lands. A number of grasses are also being studied with reference to their adaptability to dry lands in that section, where there are many thousands of acres of land too dry for any of the standard forage crops.

JOHNSON GRASS.

The agrostologists of the Bureau have demonstrated that the formidable pest known as Johnson grass may be completely destroyed by practicable means and that it may easily be held in check. They are now making demonstrations of the methods developed in their

investigations and are endeavoring to devise an implement for removing Johnson grass rootstocks from the soil.

SOILING CROPS.

With the development of stock farming and more intensive methods, particularly in the eastern half of the United States, the practice of soiling is becoming more important. Farm practice with reference to soiling crops is being studied with a view to formulating systems for all sections of the country. In this, as in all investigations, the experience of successful farmers has been of great assistance.

CROPS FOR OVERFLOWED LANDS.

The problem of utilizing lands subject to annual overflow has continued to receive attention. Particular attention has been given to short-season annual crops, such as millet, early varieties of corn and sorghum, buckwheat, cowpeas, soy beans, and rape, for lands that are free from water during midsummer and the fall season, and all these crops have been grown successfully on land that was covered with water until the latter part of June. The native grasses which are extensively cut for hay on overflowed and swamp lands are also being studied with a view to making seed of some of the best of them available on the markets, so that farmers who are in need of such grasses may be able to obtain their seed.

FRUIT-MARKETING INVESTIGATIONS.

Next in importance to ability to produce choice fruits is the existence of a sufficient demand for them at prices that will yield a fair profit to the grower. In fact, without reasonable assurance of market demand for the product at fair prices, the planting or maintenance of commercial orchards or vineyards is folly. From the nature of their product, which is at the same time perishable and an article of luxury rather than of absolute necessity to the average consumer, the prosperity of our fruit growers is more dependent upon the price of their product at the time of harvest than that of almost any other agricultural class. Glutted markets at such times are peculiarly disastrous both to individual fruit growers and to the regions in which commercial fruit culture has become an important feature of agriculture.

REMEDY FOR OVERSUPPLY.

The avoidance of gluts is, therefore, of very great importance to the entire fruit industry. While many remedies have been suggested, that which appears most practicable and reasonable is the wider distribution of the product. For this reason the chief line of investigation in fruit marketing has been the determination of methods best adapted to the harvesting, packing, storing, and forwarding of fruits

to points relatively distant from their places of production, with a view to developing wider demand for them, both in the United States and foreign countries. Chief attention has been thus far given to problems connected with the development of the trans-Atlantic export trade, the most important work having been done with summer and winter apples, peaches, and pears.

DEVELOPMENT OF EUROPEAN MARKET FOR PEARS.

While some important points are yet unsettled in connection with these fruits and require the continuation of experimental work upon them, some gratifying evidence of the practical value of this line of work appears worthy of notice. The determination of the methods of handling and packing necessary to insure safe delivery of eastern-grown Bartlett pears in European markets during the season of 1902–3 was followed in the fiscal year 1904 by large and profitable shipments of this fruit from Eastern orchards to British markets. While official statistics are not available, it is known through commercial channels that more than 75,000 packages of this variety were thus exported, while the total shipments of Eastern-grown summer and fall pears amounted to at least 165 carloads. While this is but a small proportion of the entire pear crop, its removal from the domestic market was undoubtedly an important factor in maintaining the fair prices that prevailed in our markets during that season, notwithstanding the large crop of that fruit.

SHIPMENTS OF WINTER APPLES.

Largely through the efforts of the Department, which pointed out the way through experimental shipments which demonstrated the practicability of direct shipments of winter apples to French markets, an encouraging beginning in commercial shipments has resulted. Commercial estimates indicate that during the fiscal year 1904 our direct exportation of apples to France amounted to 200 carloads, which is about twelve times as much as the annual average of the preceding five years. With systematic and judicious continuation of such shipments until consumers become accustomed to American varieties and methods of packing, the French market should rapidly become an important factor in our export apple trade.

The most important experimental export work has been done upon winter apples, as the magnitude of the apple industry warrants first attention. A series of shipments to the principal European markets, in an effort to determine the relative value of the barrel and the box as export packages for this fruit, has disclosed on the whole very little difference in the net results where ordinary "No. 1" fruit was shipped, either with or without paper wrapping. These results are not considered conclusive evidence of the relative merit of these packages, how-

ever, as it is known that in such matters repeated tests are required to insure correct interpretation of results. Additional work along this line will be done during the coming year.

EFFECT OF DEPARTMENT WORK ON EXPORT TRADE.

While exact determination of the effect of these investigations on the development of export trade can not be ascertained, it is interesting to note that a comparison of commercial estimates of the crops of the successive seasons with the exports of the corresponding fiscal years shows a steady increase in the proportion of the crop exported, as well as a large increase in the quantity shipped, the proportion exported having risen from less than 1 per cent of the estimated total crop for 1899–1900 to nearly 4¾ per cent in 1903–4, when the total was 2,018,262 barrels, valued at $5,446,473, in the latter year.

PROGRESS IN FRUIT-STORAGE INVESTIGATIONS.

The cold storage of fruit has grown to large proportions in the last decade, nearly 3 million barrels being cold-stored in the United States last year. When the Bureau began investigations along this line three years ago there was little exact information about the factors which influenced the keeping of fruit. It was popularly supposed that a cold temperature was the most important consideration in successful fruit storage, and that the frequent heavy losses were generally due to unfavorable storage conditions. As a result of the investigations, especially during the past year, it has been demonstrated that the condition in which the fruit is grown and the manner of handling it determine to a large extent the keeping quality as well as the ultimate value of the fruit. Fruit grown to unusual size, like that from rapidly growing young trees, from trees producing a light crop, or from trees forced unduly by tillage or by other orchard treatment, has been shown to deteriorate from one to three months earlier than the same variety grown more slowly.

The investigations are showing that fruit intended for storage must be handled with the utmost care in picking, packing, and shipping, and stored quickly after picking in well-ventilated rooms in a temperature of about 31° to 32° F., if the storage difficulties now most common are to be overcome.

CAUSES OF LOSS IN SHIPPING PERISHABLE FRUITS.

During the past season the Bureau has undertaken to determine what factors cause the frequent losses that occur in shipping perishable fruits, such as peaches, to distant markets. From 5 to 30 per cent of decayed and soft peaches in the top layers of a refrigerator car on arrival at destination from the Southern peach areas is not uncommon, especially in moist, warm weather. Several cars in which the fruit

was cooled quickly after picking to about 40° F. were shipped from Georgia to Northern markets. All of this fruit arrived in practically perfect condition, demonstrating that the common practice of loading perishable fruits in a heated condition is one of the important factors in causing serious economic losses. Furthermore, it was demonstrated that the cars could be loaded more heavily with little danger of the fruit in the top of the car deteriorating, and the fruit was harvested and reached the consumer in a riper and better condition on account of the better carrying quality.

FARM HANDLING AND STORAGE.

In addition to the work outlined, the Bureau is endeavoring to supply the demand for information from fruit growers by determining what cold-storage systems are best adapted to farm use.

There has been a demand for experimental work in fruit marketing and storage from fruit growers on the Pacific coast. The funds available have limited the work to the East up to this time. During the present winter the investigations will be extended to the citrus industry of California, which in the season of 1903–4 amounted to 30,000 carloads of oranges and lemons. The losses in transit and in warehouses when the warm spring weather sets in are sometimes very large. It is proposed to find out what relation the present methods of picking, packing, handling, and shipping the fruit bear to these losses, in a manner similar to the investigations with deciduous fruits.

INFLUENCE OF INVESTIGATIONS.

That these investigations in fruit storage are having an important influence in improving the commercial methods of handling our fruit products is seen in their growing application by fruit growers, handlers, and warehousemen, all of whom are making demands on the Department for information and for enlarged investigations.

NEW PLANT CREATIONS.

The plant-breeding work, heretofore described, has been continued along a number of new lines. Great advances have been made in the matter of securing new and desirable long-staple cottons. During the last three years a number of long-staple Upland varieties of cotton have been originated, and these have come to be cultivated to some extent in certain parts of the cotton belt, and very generally in the rich bottom lands of the Mississippi and Red rivers in Mississippi, Arkansas, Louisiana, and Texas. A large number of hybrids have been made for the purpose of securing Upland types of long-staple cottons, which can be put into general cultivation, and which will be superior to those now in use. Several of these hybrids are approaching fixity of type. Among these are some having a staple from 1¼ to 1⅝ inches in length.

BREEDING OF CEREALS.

In the breeding and improvement of corn important advances are being made. The main object of this work has been the selection of strains of corn best adapted to the different sections of the United States. The work is being conducted in cooperation with twenty or more State experiment stations and many farmers. Each year the Department obtains pure seed from the originators and breeders of the leading strains of corn in various sections of the country, and is sending this seed to different localties for comparative tests. At the same time extensive hybridization work is proceeding for the purpose of securing sweeter, more tender, and more productive strains of sweet corn for table use. Connected with this work, also, there are being studied problems relating to the handling of seed corn, seed selection, etc.

Extensive breeding investigations of oats have been carried on, mainly for the purpose of producing a profitable variety for the rich farm lands of the great corn-growing States, where oats are used in rotation with corn. The production of a more desirable oat for meal constitutes a part of this work. Some very promising hybrids have been obtained from the naked oat of China—the so-called "European hull-less oat."

BREEDING POTATOES AND TOBACCO.

In the improvement of potatoes important work has been conducted along two lines—(1) type selections, and (2) the production of new seedling varieties. This work was begun in 1902, and already very promising results have been obtained, especially from some of the hybrids.

Some of the most important investigations in the matter of breeding and selection have been inaugurated in connection with the growing of tobacco. This work is conducted along two principal lines—(1) the selection of individual types in the varieties, and (2) crosses between different varieties. Extensive work has been carried on in Connecticut, where both shade and outside tobacco are grown. The work conducted so far has shown unquestionably that the desirable characteristics in the leaf can be fixed from the first year's selection. In this work nine different types have been used and more than 300 selections have been made of each type. One hundred and twenty-five plants are used as a standard for each selection. Thus the work of selection alone has involved the use of something over 40,000 plants.

The work has been conducted in such a way that all the plants have been grown under tent shade, and the entire development of the leaf, from the seed bed to the manufactured product, can be followed. Allied with this work extensive investigations have been made as to the effect of hybridization. Hybrids are easily secured, and from the evidence already obtained by experience in the Connecticut Valley it

is believed that the improvement of tobacco by crossing is practicable and can be successfully carried out according to plans now in operation.

NEW FRUITS.

Other important lines of work, having for their object the securing of new types of grains, fruits, and other crops, have been carried on. Important work has been done in the matter of developing new varieties of pineapples, new varieties of pears, and other fruits.

PROGRESS IN SEED AND PLANT INTRODUCTION.

The work of introducing and establishing new plants from foreign countries has resulted during the year in the introduction of 1,429 selected kinds of seeds and plants. These have been secured through correspondence and by means of our agricultural explorers, one of whom was sent to the Russian Caucasus in search of new varieties of fruits; one to the West Indies for tropical cassava; a third made an extensive study of the European flax regions, and a fourth visited Mexico in search of southern country apricots. Such a large number of plants, introduced during previous years, remained to be adjusted to American conditions that the efforts this year, more than last, were concentrated on the domestic side of the problems, and no very extensive exploring trips were undertaken. Notwithstanding this, however, a number of new important importations were made. A shipment of over 350 date suckers, representing 42 varieties, mostly new to America, was made from the oasis of Biskra in the Sahara. Two hundred and seventy samples of different strains of European flax were collected. A collection of 19 selected varieties of grapes from the Russian Caucasus was arranged for. Two hundred and fifty pounds of seeds of the true pistache and smaller quantities of seeds of related species for stocks were imported from Turkey and Central Asia. Thirty-three varieties of mangoes of recognized superiority were secured from Central India in Wardian cases for Florida cultivators.

NEW PLANTS FROM EASTERN COUNTRIES.

A shipment of 157 bushels of berseem was made from the valley of the Nile. Two thousand pounds of the famous pedigreed Hanna barley were secured from its originator in Moravia. Two hundred trees of the hardy Vladimir cherry, for trial in the Northwest, were imported from Russia. One hundred and five varieties of French phylloxera-resistant grapevines were secured for trial in infested California vineyards. New species of the lily, from the Philippines and the Neilgherry hills of India, were introduced for breeding purposes. The yang-taw, from Central China, an entirely new fruit-producing vine, was presented to the Department by Consul Wilcox, of Hankow. A number of promising

resistant South African grapevines, a collection of Canary Island plants, some East African sorghums, and an interesting clover from Uganda were some of the gifts of Mr. Barbour Lathrop, whose expeditions in search of plants for this Department have been mentioned in previous reports.

DURUM WHEAT AND OTHER PREVIOUS INTRODUCTIONS.

Many of the important introductions from previous years still occupy the attention of the office, and either require fresh material from abroad or necessitate field experiments. The durum wheat area has been greatly extended, as already noted. A new date garden in the desert region of southern California has been established in cooperation with the State experiment station. The Egyptian cotton introductions are leading to the production of new hybrid races of promise. The Malin or Moravian horse-radish has proved a success. Japanese bamboo and Mitsumata paper plantations are being arranged for. Tropical mangosteens, imported by post, are being successfully propagated for distribution in Porto Rico and Hawaii. Egyptian clover is being given an extensive trial in Texas, Louisiana, and California. A new seedless pomelo from Siam has been grown for distribution. The Turkestan alfalfa has seeded in several localities, and the securing of American-grown seed of this variety is now a possibility.

CONGRESSIONAL SEED DISTRIBUTION.

As pointed out in my previous reports, constant efforts are being made toward the improvement of methods of securing and handling the general seeds for Congressional distribution. Improved appliances have been perfected for the mechanical work, and improved methods have been adopted for securing the seed. The work is now all under the direct supervision of efficient officers of the Bureau of Plant Industry. Every effort is being made to improve the quality of the seed by securing pure stocks. Extensive work is being conducted in the matter of a critical study of varieties under different conditions of soil and climate. Testing gardens for this purpose have been established in a number of localities, and the work is under the supervision of a thoroughly competent expert horticulturist. Every effort is being made to encourage home seed growing. Practically all of the vegetable seed now distributed by the Department is grown in the United States.

A few years ago nearly all of the flower seed, except sweet peas, was imported. Now fully 75 per cent is grown here, through the encouragement offered by the Department in this work. A special effort is put forth in the matter of distributing promising varieties of cotton, tobacco, forage crop, and other seeds. The cotton experts of the Bureau have been constantly at work securing new and desirable sorts

wherever they have been found in connection with the other cotton investigations. The results of this continuous distribution of improved strains are already beginning to show in a number of sections of the South.

In the handling of this enormous work which Congress puts upon the Department, the necessity for strict business methods has been fully observed. The work of handling one branch only of this problem involves the securing of more than 25 carloads of special seed, and the testing, packeting, and mailing of this large quantity to all parts of the United States. The systematizing of all the operations has been so perfected that there is little or no friction at the present time.

NITROGEN-FIXING BACTERIA.

Extensive practical tests were made the past season with nitrogen-fixing bacteria for use in connection with leguminous crops. The results have been even more successful than we had anticipated. Hundreds of applications have been sent in from every State in the Union for material with which to inoculate various crops. Practically all of these requests have been complied with in such a way that a record of the results could be obtained. The results show conclusively that where the organisms are used in accordance with the directions issued by the Bureau increased yields, ranging from 15 to 35 per cent, are secured. Furthermore, many farmers have been successful in getting stands of clovers and other crops on soils where failure has resulted heretofore. The several strains of bacteria sent out from the Department have proved valuable even on soils containing the uncultivated organisms in abundance. It was discovered during the year that tubercle formation is not necessary to successful inoculation.

The bacteria can be present in the roots of legumes in a very efficient state with no tubercle formation whatever. The material for inoculating an acre of soil by the methods which have been developed costs the Department about 1 cent per acre and the farmer scarcely anything to apply it. So great has become the demand for this material that private concerns have become convinced that there is profit in preparing and distributing it, and several firms are now announcing their preparedness for doing this. Widespread interest in the subject has been manifested by the agricultural press and the magazines, and as a result of this publicity the demand for the organisms is constantly increasing.

INVESTIGATION OF PLANTS POISONOUS TO STOCK.

In parts of the Northwest where sheep grazing is an extensive industry, very great losses have been experienced in many sections, due to the so-called "loco disease." This disease is commonly attributed to the eating of the loco weed, by which parts of the range are

almost monopolized. In one county in one of the Northwestern States in which sheep grazing has been the chief industry, the disease has made such inroads that many stockmen have been obliged to give up sheep grazing altogether, with the result that land values have depreciated and the sheep from this region are viewed with suspicion by buyers.

During the past two years investigations have been made to test the relation between this devastating trouble and the so-called "loco weed" prevalent in this section of the country.

FIBER PLANTS.

The textile industries using plant fibers have been growing, with increased demand for twine, cordage, and woven goods, but, with the exception of cotton, the production of plant fibers in this country has not kept pace with the consumption. The raw fiber imported during the fiscal year ended June 30, 1904, was valued at more than $47,000,000. This amount included about $9,000,000 worth of cotton, chiefly Egyptian and other grades, not produced here commercially. The other fibers imported were mostly sisal, manila, jute, flax, istle, and hemp. Investigations of all these fibers have been conducted by the Bureau, special attention being given to those likely to succeed in our own country.

DRY-LAND AGRICULTURE.

In my last annual report attention was called to the importance of developing a system of agriculture adapted to the semiarid areas of the United States where general irrigation for ordinary crops is not practicable or possible owing to the small annual rainfall and the consequent lack of sufficient water. This is true of nearly one-fourth of the entire arable land surface of this country. It is believed, however, that a profitable system of agriculture can be developed for these areas by securing crops which will grow with a very small amount of water. Considerable progress has been made in this direction and facts have been secured which show the necessity of an immediate and thorough investigation of the conditions affecting the moisture requirements of crop plants for growth in semiarid regions, such as Kafir corn, alfalfa, drought-resistant wheats, and other crops at present unknown to American agriculture.

WATER PURIFICATION INVESTIGATIONS.

Attention was called in my last report to the investigations being carried on by the physiologists of the Bureau of Plant Industry with a view to finding methods of destroying obnoxious algæ in water supplies. The method discovered consists in using extremely dilute solutions of copper sulphate. After a chemical and microscopical

study of the water to be treated, and identification of the contaminating organisms, the amount of copper required to be effective is determined and introduced in the form of sulphate. Numerous tests have been made in cooperation with boards of health and water engineers in a number of large reservoirs, and the method has proved remarkably efficient and successful. The fact that one part of copper sulphate to one hundred thousand parts of water will at ordinary temperatures completely destroy the bacteria causing typhoid fever and Asiatic cholera suggests the great usefulness of copper in fighting these diseases and other maladies caused by closely related organisms. Physicians and public health officials have taken great interest in this work, and will doubtless make prompt and thorough tests of the usefulness of copper in such cases.

CONSTRUCTION OF NEW GREENHOUSES.

The new buildings planned for the Department made it necessary to remove the glass houses now on the grounds. A special appropriation of $25,000 was secured for this purpose, and the new houses have been erected and are now complete. This new range consists of 8 modern houses, each 142 feet long, which were put up under contract. Three additional houses have been put up by the Bureau's force of workers, and two of the smaller houses have been moved from their old location to the new one. The new range is much more satisfactory than the old one, and it will be devoted to various lines of work connected with the Bureau. The contract for the new houses was let on June 1, 1904, and they were completed on September 1 of the same year.

ARLINGTON FARM.

During the year the important work of improving the soil conditions at the Arlington Farm has been continued. New systems of drainage have been put in, cottages for the superintendent and other workers constructed, barns erected, and other improvements made; and the farm has been put in shape for the advanced experimental work it is proposed to conduct there. Extensive plantings have also been made of economic fruits, ornamental trees, and other plants. Test work with potatoes, celery, forage crops, and various fruits has been carried on. Cooperative work with other Bureaus has also been inaugurated.

COOPERATION WITH STATE EXPERIMENT STATIONS.

The Bureau of Plant Industry is now cooperating with practically all of the State experiment stations in the country. The work covers investigations of diseases of plants, studies having for their object plant improvement, investigation of forage crop conditions, encour-

agement in the production of new crops and new industries, and many other lines of work. In some special cases, notably California, close cooperation has been effected, having for its object the establishment of important testing gardens and other allied work. With the assistance of the officers of the California experiment station a testing garden has been established at Chico, Cal. The land for this garden has been donated to the experiment station, to be held in trust by the station for the use of the Bureau.

It is planned to carry on extensive work here in the matter of testing grains, fruits, and other crops specially adapted to the Pacific Coast. It is the policy of the Department in all cooperative work with the stations to fully recognize the relations of the stations to the officers who control them. Furthermore, wherever the Department desires to undertake work in a State, its policy is to endeavor to do this work in cooperation with the station.

FARM MANAGEMENT.

In order to properly conduct the work on farm management, which has already been set forth in previous reports, an office has been established for the purpose. The object of this office is to bring together in systematic shape all of the available information in the Bureau in such a way that it can be placed in the hands of the farmer for his practical use. The office gathers together information concerning farm practice in all sections of the country as a basis for further work. It secures and publishes correct records of crops grown and the manner of growing them, for the information of others who desire to follow successful plans. It encourages farmers to visit and study experiment station work, the experiment stations, and the successful farmers in their own section. It encourages diversification in farming where continuous, clean cultivation of a single crop has impoverished the soil. It outlines systems of cropping for different kinds of farming in all sections of the country, and furnishes data in the matter of properly laying out farms, fruit plantations, truck gardens, etc.

BUREAU OF FORESTRY.

PRESENT FOREST SITUATION IN THE UNITED STATES.

The present outlook as regards forestry in the United States is exceedingly hopeful. The lumber industry as a whole is now awakening to the fact that lumbering with reference to future as well as present profits may be good business and ought to be taken into account on business grounds. A growing tendency to hold cut-over lands for future crops is plainly marked among far-sighted owners of large holdings. This means that conservative management on the part of those who operate on a large scale is fairly launched. Except that

further agitation is essential to give the facts publicity, the general adoption of forestry as an established policy now depends primarily on business conditions pure and simple. The question whether or not it will pay is one to be settled in each individual case by study of conditions on the ground. Forestry can not alter economic conditions; it can only use them. Forestry is now in actual practice on large, privately owned tracts in seven different States. This is the direct result of the past work of this Department in forestry.

FIELDS FOR FUTURE WORK OF THE BUREAU.

NEED OF INVESTIGATING GENERAL FOREST PROBLEMS.

Extensive investigations of forest conditions and of methods of operation are still urgently needed before the road to practical success can be said to be generally open. The employment of foresters by large private owners to supervise operations on their own lands is being taken up. In the public interest this needs to be brought about wherever conditions are favorable, but more and more the promotion of private forestry by the Bureau of Forestry can and should be made incidental to its other functions of directing the management of public forest lands and scientifically investigating general forest problems.

In the case of small owners much remains to be done. The farmers of the country are learning how to get the most out of their land in other ways through the scientific information which the Department of Agriculture collects and diffuses. So, also, in the case of timber yield, studies which individuals can not undertake but which must be made if the wealth-producing power of the country as a whole is to be brought to its highest point, need to be prosecuted in the public interest. The average small timber-land owner is to-day in many parts of the country at a decided disadvantage in comparison with the large owner, because he lacks both working capital and equally broad knowledge of general conditions. It is true that large lumbering operations can often be made more profitable than small, but it is not in the public interest that small owners should fail to make a profit which is within their reach because they do not know how best to utilize what they have now, or do not realize what it is likely to be worth in the future. Thus the furtherance of that part of this Department's work which is directed toward informing the small owner how he can to advantage practice forestry on his own account, is of the first importance for the best use of the 200 million acres of woodlots which our country contains.

SCIENTIFIC STUDIES AND AID IN CARE OF STATE AND NATIONAL FORESTS.

By its scientific studies of American forests the Bureau of Forestry has prepared a solid basis for practical forestry. Special studies of our important timber trees have yielded information obtainable in no

other way and essential to the management of forests of which they form an important part. There is now no considerable portion of the United States for which the Bureau of Forestry has not at hand special knowledge bearing directly on questions pertaining to the use of the forests. Nevertheless, what has been done is hardly a beginning in comparison with the vastness of the field.

In the work of building up a sound permanent policy for the forests of the National domain the Department of Agriculture has continued to render important services. Much of the work of the Bureau of Forestry during the year has been the examination of lands already reserved or likely to be reserved in order to recommend the exclusion from them of such areas as are more valuable for agriculture than under forest. The personnel of the Bureau of Forestry has become practically familiar, by studies on the ground, with every phase of the question of putting to the best use the public lands of the country. Thus an efficient force has been prepared by actual experience, as well as by technical, scientific training, for the demands which a fully developed National forest policy must eventually impose.

In the light of these facts it is plain that the ultimate function of the Bureau of Forestry as a part of the Government administrative equipment is gradually defining itself. Its effort to introduce forest management among large private owners at the earliest possible moment will cease to be necessary when it becomes generally successful. It was undertaken because of an evident urgent public need. Destructive lumbering had already greatly reduced the area of productive timber lands in the United States, and its continuance was a menace to the future prosperity of the country. Because of the work of this Bureau forestry has now a recognized standing in the eyes of the American lumber trade. The Bureau of Forestry is giving a smaller proportion of its time to the preparation of working plans for large timber tracts belonging to private owners than ever before, and bearing a smaller proportion of the expense, and the progress of the past year has brought visibly nearer the time when it can withdraw practically or entirely from this field.

There will then chiefly remain work along the lines of (1) scientific study of problems which have a practical bearing on forest utilization for any purpose; (2) cooperation with States which ask advice concerning forest legislation, administration, or the formulation of a State forest policy, and (3) the discharge of whatever duties may be assigned to it in connection with the administration of the public lands by the National Government.

Along this latter line it is at present the official adviser in technical matters of the Departments which have in charge forested lands under Government control, both here and in the Philippines, and it is also

chiefly responsible for recommending changes in present reserve boundaries and for recommending the setting aside of new reserves. The policy which lies at the base of the creation of the reserves is that the public forests should not be withdrawn from use, but should be managed under such restrictions as will insure their permanent usefulness. This policy this Department is actively furthering, and no part of its work is more important.

LINES OF WORK REQUIRING EXTENSION.

An increase in the funds available for the Bureau of Forestry is essential to make it possible to push its work more rapidly. It is my purpose to provide the fullest facilities for the prompt investigation of actual or proposed forest reserves, as well as for further examinations of forested parts of the public domain not now reserved which give promise of permanent value as sources of water or wood supply. The greatest need of the West is water. In many States future settlement and prosperity depend absolutely upon its conservation. This again largely, in many cases wholly, depends on the preservation of the forests. To make possible the execution and extension of the work, I have asked for an increased appropriation for the Bureau of Forestry for the coming year.

Planting on forest reserves.—The work of planting on forest reserves opens another fruitful field. In the San Gabriel Reserve in California, the Pikes Peak Reserve in Colorado, and the Dismal River Reserve in Nebraska, the planting has been begun and should be vigorously prosecuted. In the first two cases the object is to cover denuded mountain slopes with forest growth, in the interest primarily of water conservation and, in the case of the Nebraska reserve, to provide a future valuable timber supply. This planting is undertaken only after a careful preliminary survey has proved that there is an economic need for new growth which nature can not supply, and after painstaking experiment has demonstrated what methods can be depended on for success. Under these circumstances expenditure for planting is as truly economical as is that of the farmer when he purchases seed to sow that he may harvest the increase. I believe that an addition to the sum available for this work will be amply justified by the returns.

The development of economic mining will soon wait for the growth of trees within reasonable distance. The miner is an important factor in the growth of many of our States and of the country at large, and should have all facilities given him to conduct his work on the most economic basis. Where the miner ceases work the farm and factory lose a market. For this reason the miner should have the first claim on the forest for such timbers as he requires.

STUDIES IN FOREST PRODUCTS.—Auxiliary to studies of the forest itself, but of the most importance in relation to the conservative use of our forest resources, stand the studies in forest products. Among them at the present time are (1) the studies in timber preservation, especially of railroad ties, which promise such conspicuous and successful results in timber economy; (2) the experiments in timber testing, to ascertain, under such conditions as obtain in actual everyday practice, new strength determinations for use by engineers, architects, and others; and (3) the investigations of the tannin content of barks, of pulp processes, etc. In the way of securing large economies by a comparatively small outlay for investigation, no more promising field for useful work by the Bureau of Forestry is open than this.

COOPERATION WITH STATE AUTHORITIES.—The desire of State authorities for the assistance of the Bureau of Forestry in cooperative work and in framing forest legislation and their willingness to contribute to its cost are facts worth noting. State cooperative studies have now been made in Maine, New Hampshire, New York, Maryland, Michigan, Wisconsin, California, and Hawaii. Were this Department prepared to push the work along this line large results could be rapidly secured. The whole cause of forest preservation hinges on the interest of the State governments, because no matter how fully persuaded the private owner may be that forest management promises to yield him good returns, without fair assurance of safeguard against fire and of equitable taxation during the period required for a second crop to mature on cut-over lands, he can make no headway. The exclusion of fire depends on local sentiment, State legislation, and State or local police and patrol. Unless the States are awake to their duty toward this form of property the Federal Government can do little beyond caring for its own holdings. In California one result of the cooperative work now going on is the drafting of what appears to be the best forest-fire law yet drawn up in this country. The way is now open for a great advance through State cooperation if the requisite means of meeting its cost beyond the State contributions can be made available.

SUCCESS OF FORESTRY WORK.

The successive advances which have been made by Congress of recent years in the appropriation for the Bureau of Forestry offer one of the best evidences of the commendation which its work has received. More and more money has been given to it to spend because it has proved year by year its capacity to do more, and more practical, good work. It prosecutes its researches solely that it may discover and diffuse information which contributes to our National well-being. Within six years its force has increased sixteenfold and its expendi-

ture twelvefold; but neither of these facts is an adequate measure of its advance in practical efficiency or of its success in changing former conditions. By a single discovery—that the cup and gutter system, devised by one of its agents, could be commercially applied to the production of crude turpentine—it is now saving many times more annually to the naval-stores industry than the total expenditures of the Bureau during the whole six years.

It has changed forestry for business returns in the United States from an undemonstrated and doubtful theory into a well-established business operation; it has converted the lumber industry of the country from an attitude of well-grounded suspicion to one of support; it has converted the general public from indifference to what seemed an impractical outcry to an intelligent comprehension of what forestry has to offer. By bringing home to the railroads the need of economic utilization, preservative treatment, and provision for future supplies it has set on foot a movement of incalculable importance. By teaching Western farmers how to plant and grow trees for farm protection and local timber supplies it has added materially to the comfort and prosperity of vast regions and many States. More important still, by demonstrating the capacity of the forest to store water, and by energetic activity to guard from sale or destruction forests of important protective power, it has contributed to the success of National irrigation, one of the most vital developments of recent years.

NEED OF FURTHER DEVELOPMENT OF FORESTRY.

But though this Bureau has accomplished and is accomplishing practical results out of all proportion to its money expenditure, this is not exceptional in the Department of Agriculture, and forms in itself no justification for a further increase. The question is simply in each case whether the country will be better off by spending the money or by not spending it. There are, however, certain special reasons why the Bureau of Forestry should have made, and should for some time continue to make, an exceptionally rapid growth. Its task is virtually that of building up a new science in this country, combined with that of getting its discoveries recognized and applied by a public once little alive to their value. No other branch of agricultural science has recently been in such need of development, and in the whole history of agricultural progress I believe that no other similar development was ever more timely. This development took place because of the unparalleled National need created by the vastness of the interest involved and the critical point which forest destruction had reached. And there is still much to be done before this new science can overtake the nation's requirements.

WORK ACCOMPLISHED DURING THE YEAR.

COOPERATIVE STATE FOREST STUDIES.

Forest studies in cooperation with State or Territorial governments were carried on during the year in New Hampshire, Maryland, Wisconsin, California, and Hawaii. A report on the work in New Hampshire is now in the hands of the printer. It contains a thorough study of the main forest resources of the State, and will afford a satisfactory basis for the adoption of a broad and far-sighted State forest policy.

The study in Hawaii resulted in the publication of a bulletin on "The Forests of the Hawaiian Islands," in the adoption by the Territorial government of its recommendations, and the appointment of a member of the Bureau of Forestry as superintendent of forestry in the islands.

A map and report embodying results of the work in Maryland will appear in the annual report of the State geologist.

In California over 20,000,000 acres of forest were mapped and described; the growth of planted eucalypts was studied; important investigations of the effects of chaparral cover on water conservation and on the forest, and of the forest replacement on denuded areas, were prosecuted; and the study of forest fires was continued, with the result that what is believed to be the best fire law ever prepared for State enactment has been drafted for presentation to the legislature.

FOREST MEASUREMENTS.

Of forest measurements there were handled during the last fiscal year the results of over 24,000 acres of valuation surveys, over 33,000 analyses of trees, 16,000 height measurements, and 2,300 taper measurements. The volume of this work does not, however, measure its importance. In computing, compiling, and digesting the mass of information supplied by the field studies of the Bureau the accumulation of details would count for little if the results were worked up by purely routine or mechanical methods. The task imposed is to create a body of scientific knowledge by developing to significant conclusions the raw material turned in—a task calling first of all for intelligence and insight. The result is real advance in accurate knowledge of forest conditions and increasing ability to direct practical operations. Both in the preparation of working plans and in the special studies of commercial trees and forest problems which have been made during the year the efficiency of the work included under forest measurements has been demonstrated.

FOREST MANAGEMENT.

The work of the Bureau under the act of Congress of June 27, 1902, known as the Morris bill, has proved that conservative lumbering under practical regulations pays in the white-pine region of northern

Minnesota. In point of fact a higher price was obtained for the timber sold under that act, to be cut and removed under rules prescribed by the Forester, than similar adjacent timber brought shortly before, when sold without such restrictions. On about one-fourth of the 200,000 acres to be lumbered the 5 per cent of timber to be left standing had been selected and marked at the end of the fiscal year.

During the year applications for assistance in introducing forest management on private holdings were received from 47 owners of large tracts, covering nearly 4,000,000 acres, and from 89 owners of woodlots with a total area of about 6,600 acres. The field work for eight working plans for large tracts, covering about 1,000,000 acres, was completed, and for 68 woodlots of nearly 19,000 acres total area.

The eight working plans for large tracts were studies of typical problems in five widely separated States. In Minnesota a tract of land formerly covered mainly with white and Norway pine, a large part of which has been lumbered and is now entirely unproductive, presented a characteristic example of much of the remaining forest land of the lake region. The plan of management devised provides for reproduction from seed trees and for fire protection. In Alabama a working plan was prepared for two forests of virgin longleaf pine, owned by one company, which wished to be assured of a continuous mill supply. In Texas another longleaf-pine study completed during the year furnished the material for estimating present and future yields of longleaf and at the same time demonstrated the wastefulness of some of the lumbering methods now commonly followed.

In West Virginia a tract covered with hardwood, hemlock, and spruce forest, much of which is in poor condition, was studied to ascertain the practicability of management. In New Hampshire three working plans were prepared: one for a tract where the requirement was primarily the improvement of a forest-park property; the second for the tract of a manufacturing company wishing to secure a steady supply of box boards and increase the productiveness of the forest; and the third for a White Mountain tract, where the chief requirement was a system of fire protection.

Commercial tree studies of the year included balsam fir, paper birch, poplar, loblolly pine, and red gum.

DENDROLOGY.

Reports which mark the conclusion of the field studies of Missouri swamp forests and Ohio hardwood forests, and of the laboratory studies of gums, resins, tan barks, and pulp-wood fibers conducted in cooperation with the Bureau of Chemistry, were completed during the year. Field work was completed in the studies of California big trees and bristlecone fir, and of turpentine orcharding and laboratory work in a cooperative investigation of turpentine adulterants. A descriptive study of the forests of Suffolk and Nassau counties, Long Island,

was begun and finished; investigations of Pacific coast tan-bark trees and of basket-willow culture were continued; and an investigation of methods of turpentine distillation, with special reference to improving commercial processes of production in this country, was begun. Experiments bearing on the culture of the sugar maple were made to supplement a study of the sugar-maple industry previously completed. The collection of forest photographs received notable additions by exchange with foreign countries, and by gifts as well as by the normal increase from the new photographs obtained by the Bureau of Forestry in connection with its field work.

FOREST EXTENSION, FOREST FIRES, AND SPECIAL STUDIES.

In the work of cooperation with private owners to promote forest planting the Bureau of Forestry prepared during the year 42 planting plans for an aggregate of over 2,800 acres. Altogether 334 planting plans have been made for land in 52 States and Territories. This is a work of high utility, particularly in those regions of the West where timber and water are scarce and farm protection against hot or cold winds is important. Cooperation is confined to the giving of expert advice; all the expense of the planting is borne by the owner. By the adoption of a system of regional studies rapid progress is being made toward a point at which this expert advice can ordinarily be given by correspondence. When this point is reached, the Bureau of Forestry will be in a position to contribute materially to the well-being of wide regions at almost no expense.

In forest-reserve planting extensive operations are now under way in Nebraska, where previous experiments have pointed out how planting on a large scale can be made successful. In the spring of 1904 there were taken from the nursery and planted in the Dismal River Reserve 300,000 seedlings, of which over 90 per cent survived. Highly efficient and economical methods of doing this work were devised. Preliminary preparations for planting were made in the Niobrara Reserve, Nebraska, the San Gabriel Reserve, California, and the Pikes Peak Reserve, Colorado.

Studies of natural forest replacement were conducted in Colorado, western Kansas, western Nebraska, northern New Mexico, and New England.

The investigation of forest fires, with especial reference to methods of preventing and controlling them, has been continued, and encouraging progress made. The study of the reclamation of shifting sand through forest growth was continued.

TIMBER PRESERVATION, STRENGTH, AND MECHANICAL PROPERTIES.

The studies in timber preservation conducted by the Bureau of Forestry are yielding results of large economic importance. Extensive experiments were conducted during the year in the West with

longleaf, shortleaf, loblolly, lodgepole, and western yellow pine, spruce, and white and red fir ties. Ties were employed for these tests partly because of the opportunities for experiments of general application afforded by the selection of this form of timber, and partly because of the intrinsic importance of the specific subject of tie preservation. These experiments have already developed a number of important facts connected with timber seasoning and preservation.

In the Central States similar experiments were made with a large number of hardwood timbers, especially with those possibly capable of filling the place for certain uses of white oak and hickory, the supply of which is dwindling fast. It was found that chemical treatment will permit their use for structural purposes; that conspicuous improvement in present methods of seasoning is possible; and that the effectiveness of preservative treatment of red oak is greatly increased by thorough seasoning both before and after treatment.

In the East the seasoning of and application of preservatives to telegraph and telephone poles and cross arms were investigated, and discoveries which render possible considerable economies were made. Further experiments to reduce the rate of decay of poles at the butt are under way. Seasoning experiments are in progress with Adirondack hardwoods.

The investigation of the strength of timbers directly meets the needs of engineers, architects, and others who have to do with the use of construction timber, and is likely to be followed by a revision of specification requirements and grading rules. Large timbers in market forms and sizes, of red fir, western hemlock, and loblolly and longleaf pine were tested. Eastern investigations of many species are needed in the interest of the most economical use of our timber supply; for it is undoubtedly true that timber trees neglected hitherto will be found to possess unsuspected value.

Other important lines of investigation pursued were a study of the mechanical properties of red gum, which established, among other things, its suitability for carriage manufacture; studies of the relative strength of various forms of tie fastenings and of devices to prevent the rapid wear of soft timbers protected against decay by preservative treatment; and a study of the effect of moisture content on the strength of timber.

LOUISIANA PURCHASE EXPOSITION FOREST EXHIBIT.

The most extensive and complete forest exhibit ever made by this Bureau was installed at the Exposition at St. Louis. It included the execution out of doors of tree-planting plans and the setting of trees adapted to every part of the country, and an exhibit of the best forest nursery methods. A full exhibit by transparencies, pictures, and apparatus illustrated every phase of our forestry work and forest con-

ditions in all parts of the country. Methods of testing commercial timber were illustrated, and an experimental plant for wood preservation was established and operated during the Fair.

BUREAU OF CHEMISTRY.

The Bureau of Chemistry, during the last few years, has expanded the sphere of its activity in many directions.

AID TO OTHER DEPARTMENTS.

First to be noticed of this expansion is the work done under that authorization by Congress which secures the services of this Bureau for the other Departments of the Government. Under this authority the amount of work which has been done for the other Departments has rapidly increased. This is especially true of chemical determinations in collaboration with the Treasury Department.

For the Department of Justice extensive investigations have been undertaken to determine the injuries suffered by forest reserves from the fumes of smelters. For this Department, also, numerous chemical investigations have been made in connection with cases arising in the administration of justice in the Indian reservations and in certain cases of poisoning which have occurred within those reservations.

For the Post-Office Department extensive examinations have been made of stamping pads and the inks used therewith; also of alleged remedies offered by advertisements through the mails and regarded by the postal authorities as fraudulent in their nature.

For the various Departments a large number of analyses have been made of articles offered under contract to determine whether these articles are of the quality and purity specified in the contracts.

FOOD INSPECTION.

The second important item in the expansion of the work of the Bureau of Chemistry has been the establishment of inspection for imported food products. Attention is invited to the fact that under this law the character of food products imported to this country has been greatly improved.

In former years the United States was regarded as the dumping ground for the refuse teas of the commerce of the world. Many years ago, in order to overcome this evil, a system of inspection of imported teas was established and has since been maintained. Under the beneficent working of this system Americans are now certain of being able to purchase pure and wholesome tea, since it is almost impossible for spurious and adulterated teas to find their way into this country. Congress has now extended this system of inspection to all foods, beverages, and condiments imported into the United States. There

is every reason to believe that when this system is thoroughly established an improved condition comparable to that which has taken place in teas may be anticipated.

FOOD STANDARDS.

Another important advance which deserves special attention is that relating to standards of purity for food products. The Secretary of Agriculture has been authorized by Congress to fix standards, and in order that they may be just and reasonable he has been authorized to call to his assistance the experts of the Association of Official Agricultural Chemists and other experts, as he may see fit, to advise him in regard to such matters. The work of ascertaining these proper standards, in collaboration with the Association of Official Agricultural Chemists, has been committed to the Bureau of Chemistry. Already considerable progress has been made along this desirable line of investigation and a number of standards of food products have already been fixed by proclamation. It is proposed to extend this useful work until practically all the substances used by our citizens as foods, beverages, and condiments shall have a fixed standard of purity to which all manufacturers may attain by proper care in the preparation of products of this kind.

EXPERIMENTS WITH BORAX IN FOOD.

The work of the Bureau of Chemistry in the study of the effect upon digestion and health exerted by preservatives, coloring matter, and other substances added to food has been continued in the same painstaking and thorough manner as in the preceding year. The great quantity of data secured in this work in relation to the effect of borax has been compiled and is now being published. These studies of the effect of borax have led to certain definite conclusions which are of the utmost interest to manufacturers of food products into which borax has often been introduced, and to the consuming public.

The effects of the preservatives upon the functions of the body have been studied in detail. It is admitted that there is a necessity for mineral substances in the blood, as they are essential to the functional activity of the various organs of the body, irrespective of any part they may take in direct nutrition. The necessity, for example, of saline solutions in the blood is known to every physiologist, but it is evident that these saline solutions can be derived from materials of common occurrence and naturally found in food products, or usually added thereto as condiments, such as common salt.

At the same time it must not be forgotten that this does not excuse the introduction of other soluble bodies which have a detrimental effect upon the functional activities, and the excretion of which imposes an additional burden upon the excretory organs. For although such

substances might not impair the efficiency of these organs for a number of years, they would finally produce a condition of exhaustion which would be followed by serious consequences.

USE OF SMALL QUANTITIES AS PRESERVATIVE.

The argument that small quantities of deleterious substances may be used without harm is not logical, nor can it be based upon the result of the experiments which have been made. On the other hand, the logical conclusion which seems to follow from the data at our disposal is that the use of boric acid and equivalent amounts of borax should be restricted to those cases where the necessity therefor is clearly manifest, and where it is demonstrable that other methods of food preservation are not applicable, and that without the use of such a preservative the deleterious effects produced by the foods themselves by reason of decomposition would be far greater than could possibly come from the use of the preservative in minimum quantities. In these cases it would also follow, apparently as a matter of public information, and especially for the protection of the young, sick, and debilitated, that each article of food should be plainly labeled and branded, so as to show the character and quantity of the preservative employed.

EFFECT UPON HEALTH OF VARYING AMOUNTS OF BORAX.

The most interesting of the observations which were made during the progress of the experiments was in the study of the direct effect upon health of boric acid and borax when administered in food. When boric acid or its equivalent in borax is taken with the food in small quantities, not exceeding half a gram (7½ grains) a day, no notable effects are immediately produced. The medical symptoms of the cases in long-continued exhibitions of small doses, or in large doses extending over a shorter period, show in many instances a manifest tendency to diminish the appetite and to produce a feeling of fullness and uneasiness in the stomach, which in some cases results in nausea, with a very general tendency to produce a sense of fullness in the head, which is often manifested as a dull and persistent headache. In addition to the uneasiness produced in the region of the stomach, there appear in some instances sharp and well-located pains which, however, are not persistent. Although the depression in the weight of the body and some of the other symptoms produced persist in the after periods, there is a uniform tendency manifested after the withdrawal of the preservative toward a recovery from the unpleasant sensations in the stomach and head above mentioned.

The administration of boric acid to the amount of 4 or 5 grams per day, or borax equivalent thereto, continued for some time, results in most cases in loss of appetite and inability to perform work of any kind. In many cases the person becomes ill and unfit for duty. The

administration of 3 grams per day produced in many cases the same symptoms, although it appeared that a majority of the men under observation were able to take 3 grams a day for a somewhat protracted period and still perform their duties. They commonly felt injurious effects from the dose, however, and it is certain that the normal man could not long continue to receive 3 grams per day.

In many cases the same results, though less marked, follow the administration of borax to the extent of 2 grams and even of 1 gram per day, although in some of the cases studied the illness following the administration of borax and boric acid in those proportions may be explained by other causes, chiefly la grippe.

The administration of borax and boric acid to the extent of one-half gram per day yielded results markedly different from those obtained with larger quantities of the preservatives. This experiment, conducted as it was for a period of fifty days, was a rather severe test, and it appeared that in some instances a somewhat unfavorable result attended its use. On the whole the results show that one-half gram per day is too much for the normal man to receive regularly. On the other hand, it is evident that the normal man can receive one-half gram per day of boric acid, or of borax expressed in terms of boric acid, for a limited period of time without much danger of impairment of health.

It is, of course, not to be denied that both borax and boric acid are recognized as valuable remedies in medicine. There are certain diseases in which these remedies are regularly prescribed, both for internal and external use. The value which they possess in these cases does not seem to have any relation to their use in the healthy organism except when properly prescribed as prophylactics. The fact that any remedy is useful in disease does not appear to logically warrant its use at any other time.

It appears, therefore, that both boric acid and borax, when continuously administered in small doses for a long period or when given in large quantities for a short period, create disturbances of appetite, of digestion, and of health.

TESTING OF ROAD MATERIALS.

The work of the Road Material Laboratory, now the Division of Tests, has been much broadened and its value and importance increased during the past fiscal year. The routine tests on road materials are carried on as usual, and several of the tests have been improved and standardized. The importance of testing rocks to be used in road building is being recognized at the present time by the leading highway engineers of the country, and a number of laboratories modeled after the Department Road Material Laboratory have been established in different places.

STUDY OF CLAYS FOR ROAD MAKING.

Of the 228 samples of road materials reported for the past year, 35 were clays. This is mentioned to show the high percentage which clay bears to the whole number of samples received; for it is a fact not generally recognized that in vast areas throughout the country clay is the only material of which roads can be built. For this reason much time has been spent in studying the physical properties of clays in the endeavor to devise methods by which they can be utilized in road making. It may be mentioned here that up to the present time but one method of using clay in road building has been known—that is, to mix it in the proper proportion with sand. This method, however, is not always practicable, for in many districts sand is difficult to obtain. Many of the Western railroads running through areas of the country where rock ballast was impossible to obtain have been in the habit of burning or clinkering clay with open wood and coal-slack fires along the line of their roads. This clinkered clay has been successfully used for some time past as a railroad ballast.

Many inquiries had been received as to methods of treating roads in some of the Western and Southwestern States, where, owing to absolute lack of hard materials and to the extremely sticky nature of the country clays, many of the farmers were absolutely cut off from the towns during the wet portions of the year. It was apparent that if the local clays could be cheaply burnt to a hard, dense clinker a good road material could be provided. Preliminary to actual work on a large scale and expensive experiments on the ground, it was necessary to make laboratory tests of the clays to see whether they would burn to a dense, hard clinker. Samples of the well-known so-called gumbo clay were sent to the laboratory from the Yazoo district of Mississippi. These samples were experimentally burned in the laboratory of the Division, and it seemed quite possible to use the clays in the manner as indicated above.

Following upon this experiment, the Office of Public Road Inquiries built an experimental road in Yazoo City which has been reported successful. It is needless to point out the great importance of the success of such experiments in relation to road building in localities in which no rock is to be had.

USES AND SUPPLIES OF CLAY.

Since it is shown by many letters of inquiry that information is being sought by people all over the country on the subject of testing of clays for the various purposes for which they are used, other than road building, special tests are now carried on to that end. A furnace has been installed and actual burning tests on clays are now made. In order to further stimulate interest in the development of native clay

bodies, a special circular was issued on "The useful properties of clays." The aim of this circular was to give information in the simplest possible way to people who were not supposed to possess technical knowledge of clays. That the object has been attained is shown by the increased correspondence of the Division on this subject. The circular particularly points out that for the year 1902, the last year for which the official figures are available, the total imports of foreign clays to this country were valued at $1,154,805, while the domestic clays produced were valued at $2,061,072. Since the country possesses unusually fine clay bodies, a great many of which up to the present time await development, any stimulation of interest among the people to develop our native clays must be of great value.

CEMENTING POWER OF ROAD MATERIAL.

The satisfactory investigation of the important property of binding or cementing of road materials when used upon roads has been continued and much new evidence has been obtained.

Under the old rule-of-thumb methods of road building one sort of rock was supposed to be as good as another. Miles and miles of expensive roads have been built in a haphazard way, of any sort of material that was available, and many of such roads have "raveled" and gone to pieces almost as rapidly as they could be built. Since the establishment of the proper methods of testing and investigating these materials, there has been noticed a great improvement of roads. The most intelligent and progressive of the State highway engineers are availing themselves of the opportunities extended to them by the Department of Agriculture for studying and familiarizing themselves with the physical properties of the materials which they are about to use before risking the public moneys in expensive work.

The hardness and toughness of a rock which is going to be used on a road are, as everyone knows, important properties, but the property which causes this rock under the influence of traffic to bind or cement together so as to form a smooth, even, impervious shell on the surface of a road is even more important. When the work of the Road Material Laboratory first began the importance of this quality had hardly been recognized, and absolutely nothing was known as to the reason why one rock should possess this property to a very high degree and another of perhaps identically the same name and species should be entirely lacking in it. The closest investigation has been given to this subject and to the collection of all possible data and information, not only from the theoretical and laboratory standpoint, but also from a practical point of view. It is safe to say that its satisfactory solution has been accomplished. A bulletin on "The Cementing Value of Road Materials" has just been published, and the publication of more work in the same line will follow shortly.

A new test for determining the toughness of rock and asphalt mixtures for road building was brought out during the past year, and several new tests are at present being developed.

CONCRETE FOR FENCE POSTS, ROOFS, ETC.

On the 1st of last July the Road Material Laboratory was made a Division, and its name changed to the Division of Tests. The object of this change was to establish in the Department a laboratory where all materials of construction relating to agriculture could be tested and allied problems investigated. In pursuance of this change, several lines of research have been taken up. The first problem selected was to determine whether or not a thoroughly practical concrete fence post reenforced with steel could be made sufficiently cheap to be used by farmers. The advantages of such fence posts would be many. The price of wood, particularly of the varieties used for fence posts, is continually rising, and even now the price is almost prohibitory in some sections of the country. Further, a properly constructed concrete fence post would be permanent, as it would neither rot nor undergo disintegration. A variety of methods of reenforcement have already been tried, and the experiments are being pushed as rapidly as possible. The results so far obtained have been most satisfactory.

Experiments of a similar nature to the above are about to be begun on methods for making concrete drains, watering troughs, roofs, and barns, with the hope that concrete construction, so rapidly developing in the large cities, can be applied with benefit to the farm.

The question of the structure and constitution of hydraulic cements is a matter of the very greatest importance. The Division of Tests has in preparation a paper which I have good reason to believe will be accepted as the solution of this much-discussed question.

USE OF OIL ON ROADS.

Much interest has been felt in different parts of the country in the use of oil for treating the surfaces of highways, in order to lay the dust and to offer a hard, impervious, waterproof surface. It is well known that in California such treatment of roads has met with a high degree of success. Similar experiments, however, when carried out in the East, proved complete failures; the Eastern oil failed to bind on the surface of the road, and did not lead to the desired result. When it was found that the main difference between the California natural oils and the Eastern and Texas oils lay in the fact that the California oils contained an asphalt base, while the Eastern oils contained a petroleum or vaseline base, the Division of Tests immediately suggested that the cause of the failure of previous Eastern experiments was directly due to this fact, and road builders throughout the country

were urged to make experiments with mixtures of crude oils with crude asphaltum. Last summer the Commissioners of the District of Columbia consented to make such an experiment. A street in Washington was selected for the purpose and a number of mixtures of Southern crude oil and asphaltum were spread in adjacent sections. At first the experiment was looked upon as a failure, but the road has been steadily improving, and at present there is every promise of the experiment proving a success. If it proves true that mixtures of Eastern crude oil and asphaltum make as good roads as the California oils do, a very great advance will be made toward the betterment of our rural highways.

SCHOOL FOR ROAD BUILDING.

One of the chief lines of work for this division during the present year is the establishment of a school of road building. The object of this school is to give a one-year course in highway engineering and the testing of road materials to about four young men who have received degrees from reputable engineering schools. These students are to be selected by a civil-service examination. They will devote six months to the study of road-building problems and road materials and six months to field work, which will consist of actual road construction. Men with such training are sure to be of the greatest service to the country, not only in constructing highways, but in disseminating accurate knowledge on highway construction.

BUREAU OF SOILS.

The study of soils and their management with regard to their values for producing crops has been continued. The composition of soils varies greatly in different localities and in quite limited areas. Our soils were nearly all fertile originally, but continued cultivation has in many cases reduced their powers to grow crops as they did when first brought under the plow. The best methods of restoring soils that have been cultivated too long is a pressing question not only in the older settled States, but is insistent in most of the newer lands of the West where wheat has been grown until profitable crops of it are no longer to be had.

Rotation of crops and laying down in pastures to be grazed until the soil fills with roots is the well-known restorative, but soils vary greatly in our several States and are adapted to the growth of special crops in our several latitudes, so that a general knowledge of their composition is of prime importance before the tiller can put them to their most profitable uses. Droughts limit the yield on soils that have lost their organic matter through continued cultivation without an adequate return of fertilizers in the shape of decaying vegetation. Commercial

manures will not adequately remedy the evil, as they do not return to the soil what enables it to retain moisture. Soils vary so much in this regard, from coarse sand to retentive clay, that each requires careful study to enable the farmer to manage it to the greatest advantage.

The Bureau of Soils is mapping our various areas to the end that the residents on each may as soon as possible learn the peculiarities with which they have to deal. This work is comparatively new. Its value has been overlooked by the educator. A force of soil experts is being trained in the Department to help the cultivator to a better knowledge of the possibilities of his acres throughout our broad land, in order that run-down lands may be reclaimed and that the fertility of our newer lands may be maintained to meet the requirements of a rapidly increasing population.

We are bringing plants from all foreign countries to diversify our industries and enable our husbandmen to grow what has been and still is costing us large amounts of money. A knowledge of the character of the soils from which they come and on which they have been developed is imperative, and suggests to us the wisdom of becoming familiar with the soils as well as the climates to which we introduce them, if we are to maintain them here in their excellence or improve them, giving them better conditions than they had in the countries where we found them. Within the limits of our climates and soils we hope to improve everything we import through a superior aggregation of scientists who are making research into all the conditions of plant life, the soil being of greatest importance.

PROGRESS OF THE SOIL SURVEY.

The area surveyed and mapped during the fiscal year was 29,058 square miles, or 18,597,120 acres. The area surveyed during the preceding fiscal year was 23,293 square miles, which, together with the work done prior to that time, makes a total area surveyed up to that date of 74,795 square miles, or 47,868,800 acres.

The work was carried on during the past year in 68 areas in 33 States. On an average 20 parties have been working continuously throughout the year, in the Southern States during the fall and winter and in the Northern States during the spring and summer months.

The areas surveyed and the cost of the work in each area are shown in the following table:

Areas surveyed and mapped during fiscal year ended June 30, 1904, and the areas previously reported.

State or Territory.	Work during 1904.	Work previously reported.	Total area surveyed.	
	Sq. miles.	*Sq. miles.*	*Sq. miles.*	*Acres.*
Alabama	2,396	1,223	3,619	2,316,160
Arizona		611	611	391,040
Arkansas	626	251	877	561,280
California	1,679	3,921	5,600	3,584,000
Colorado	228	1,345	1,573	1,006,720
Connecticut		518	518	331,520
Delaware	314		314	200,960
Florida	485	548	1,033	661,120
Georgia	853	757	1,610	1,030,400
Idaho	58	1,077	1,135	726,400
Illinois	2,333	3,592	5,925	3,792,000
Indiana	889	387	1,276	816,640
Iowa	1,287	1,016	2,303	1,473,920
Kansas	999	464	1,463	936,320
Kentucky		837	837	535,680
Louisiana	1,446	942	2,388	1,528,320
Maryland	29	2,634	2,663	1,704,320
Massachusetts	386	410	796	509,440
Michigan	517	858	1,375	880,000
Minnesota		233	233	149,120
Mississippi	1,352	1,317	2,669	1,708,160
Missouri	1,111	919	2,030	1,299,200
Montana		107	107	68,480
Nebraska	1,195		1,195	764,800
New Jersey		1,303	1,303	833,920
New Mexico		129	129	82,560
New York	986	1,558	2,544	1,628,160
North Carolina	687	4,646	5,333	3,413,120
North Dakota	386	856	1,242	794,880
Ohio	1,400	1,355	2,755	1,763,200
Oregon	60	386	446	285,440
Pennsylvania		1,204	1,204	770,560
Porto Rico		330	330	211,200
Rhode Island	500		500	320,000
South Carolina	1,159	2,032	3,191	2,042,240
South Dakota		485	485	310,400
Tennessee	1,596	547	2,143	1,371,520
Texas	2,564	1,733	4,297	2,750,080
Utah	306	994	1,300	832,000
Vermont	227		227	145,280
Virginia	656	2,747	3,403	2,177,920
Washington		510	510	326,400
West Virginia	39		39	24,960
Wisconsin		955	955	611,200
Wyoming	309		309	197,760
Total	29,058	45,737	74,795	47,868,800

RECAPITULATION.

Cost of field work	$64,238.36
Supplies	1,464.18
Traveling expenses between areas	4,115.55
Other expenses	2,783.32
Total cost of soil survey	72,601.41

Paid by State organizations		$2,377.57
Paid by Department of Agriculture		70,223.84
Area surveyed	square miles..	29,058
Cost of work in field per square mile		$2.21
Transportation, supplies, and other expenses, per square mile		.29
Average total cost per square mile		2.50
Average cost to Department of Agriculture per square mile		2.42

The cost of the work in the field has increased from $2.19 per square mile, reported last year, to $2.21 per square mile during the year just closed; while the average cost of the work to the Department of Agriculture, including all transportation, supplies, and office expenses, has decreased from $2.63 per square mile, reported last year, to $2.42 per square mile during the year just ended.

There has been a continued demand for this soil-survey work, and there are on file demands for about two years' work yet unfilled, while requests continue to come in which can not be immediately considered.

There has been a steady demand from colleges, experiment stations, and private enterprises for men trained in this soil-survey work, and during the past year several men have left this Bureau to accept more lucrative positions elsewhere.

PUBLICATION OF THE REPORTS AND MAPS.

At the last session of Congress provision was made to print in the form of "advance sheets" the several reports as they are prepared—500 copies for the use of each Senator from the State, 2,000 copies for the use of each Representative of the Congressional district or districts in which the survey is made, and 1,000 copies for the use of the Department of Agriculture. Although this act was passed too late to materially influence the printing of the report of the work for the field season of 1903, it will very greatly facilitate the distribution of the report and is proving a very advantageous way for the printing and distribution of the report of the work for the field season of 1904, the manuscript of the first reports of which have already gone to the Public Printer.

ALKALI-LAND RECLAMATION.

In my last report attention was directed to the important results obtained in the reclamation of alkali soils by underdrainage and surface flooding. This work was undertaken as an object lesson to farmers in those irrigated districts of the West where any considerable trouble had been experienced with the rise of alkali and the consequent depreciation in the value of the land. The results of the past year have again proved the wisdom of inaugurating these demonstration experiments in alkali reclamation. Great interest in the work has been aroused on every side, and frequent inquiries have been received from farmers owning alkali land asking instructions as to the best methods to prevent the further deterioration of their lands and advice as to the reclamation of tracts now partly or wholly unproductive.

PROGRESS IN UTAH AND CALIFORNIA.

On the reclamation tracts established during 1902–3 much progress has been made during the past year, and indications point to the complete reclamation of the lands under experimentation at an early date. On the 40-acre Swan tract, near Salt Lake City, the results have been especially gratifying. At the inception of the work there, in September, 1902, a detailed soil survey showed the first 4 feet of soil over the 40 acres to contain more than 6,650 tons of soluble salts (alkali). In May, 1903, there had been removed in the drainage water, by actual measurement, nearly 50 per cent of this immense total, and in the October following the proportion removed had reached 82 per cent, thus leaving only 1,221 tons of the original 6,650 tons still in the 4-foot section of the entire tract. The greater part of the salt originally in the surface foot had been removed, while even the fourth foot had lost 69 per cent of the alkali originally present.

In the spring of 1904 this tract was sowed to oats, barley, and wheat, as it was believed to be sufficiently sweetened for shallow-rooted crops. The land was not in the best condition for seeding. Nevertheless, on many of the checks 90 per cent of a stand was secured, and on all checks but little evidence of alkali was observed. The flooding process was resumed on those checks having the poorest crop prospects, and will be continued on all the tract after harvest, and by next spring it is expected that reclamation will have progressed to such an extent that the deep-rooted alfalfa can be grown, when the land will be returned to the owner. The growing of the crops of the present year and the seeding of the land to alfalfa are under the control of the Utah experiment station in cooperation with the Department.

The progress of a similar work on a 20-acre tract at Fresno, Cal., has been no less gratifying than that at Salt Lake City. The problem here as regards the drainage was more difficult, as the water had to be removed by pumping, while the soil was fine and silty and clogged the drain pipes. These difficulties have been surmounted, however, and within a year it has been possible to grow crops of alfalfa and wheat on a considerable part of the 20 acres under experiment. The Fresno work I deem particularly important, as it is situated in a wealthy district, where large areas of once productive land have been abandoned because of the rise of alkali and the swamping of areas by seepage water from the excessive irrigation of higher lying lands and from the canals.

EXPERIMENTS IN WASHINGTON, ARIZONA, AND MONTANA.

In the Gervais tract, situated 3 miles from North Yakima, Wash., it is estimated that flooding from July to November, 1903, washed approximately 70 per cent of the total salts out of the soil to a depth of 4 feet. Here, as in the Fresno area, much valuable land has been

ruined by seepage water and the rise of black alkali. Flooding of this tract was resumed in 1904, and it is expected that reclamation will have progressed to such an extent that crops can be grown in the coming season.

A more recent experiment has been instituted at Tempe, Ariz., where the installation of the drains was completed in February, 1904. An unprecedentedly dry season and a consequent lack of water have prevented much progress in the work at this point.

Another tract has been taken up for reclamation work near Billings, Mont. This tract is situated in the Yellowstone River Valley, where great progress has been made in growing alfalfa as a winter feed for the cattle and sheep that pasture on the adjoining mountain ranges during the summer. Shortly after irrigation began in this district alkali began to appear and the ground water rose rapidly, waterlogging wide areas of the land to such an extent that its cultivation had to be discontinued. An examination of certain parts of the valley, made by the Bureau of Soils in 1897 and 1898, showed the extent of the damage, and when, in 1902, a detailed soil survey was made around Billings it was found the trouble had greatly increased and intensified. Even in the two years that have elapsed since the survey was made, many fine alfalfa fields have been abandoned and now are heavily incrusted alkali flats. The farmers here are fully alive to the seriousness of the situation, but seem unable to cope with the problem.

SUCCESS OF THE WORK.

Many tracts of land were offered the Department for the purpose of experiment, and a number of farmers have indicated their intention to undertake similar work themselves, showing the interest taken in the work. This, however, has not proceeded far enough to permit a full report at this time. I have, however, the fullest confidence in the final success of the undertaking, as well as a firm belief that it will lead to individual or concerted action on the part of those of our citizens most interested, with the result that both the agricultural and stock-raising interests of this part of the country will be greatly benefited.

It seems, then, that within three years, at most, practically worthless land, so heavily charged with injurious salts as to be unfit for any form of agriculture, may be reclaimed to grow any ordinary field crop; that the method of doing this is simple; and that the expense involved is such that the work may in many instances be economically undertaken by individual, corporate, or State initiative. Taking the Utah tract for example, the land reclaimed has increased from a purely nominal value to an actual value, judged by the value of surrounding unaffected lands, of $250 to $300 an acre. The total expense of reclamation, taking everything into consideration, is but a small fraction of this enhanced value.

TOBACCO INVESTIGATIONS.

In the line of tobacco investigations carried on by the Bureau of Soils the most important work during the past fiscal year has been the experimental growing of Cuban seed tobacco on certain soils in Texas, Alabama, and South Carolina. This work was begun in July, 1903, in cooperation with leading farmers in the several States. Thirteen acres were planted in Texas, 3 in Alabama, and 3 in South Carolina. The success of this first trial led to further plantings by the Department in 1904, when trial tracts were established at Nacogdoches, Crockett, and Giddings, in Texas, a total of 12 acres being planted. One tract in Perry County, Ala., and one in Orange County, S. C., were established, each with 3 acres in tobacco. Samples of the tobaccos grown in 1903 were submitted to the trade, and the opinion is that the Texas leaf has considerable merit, both in regard to flavor and aroma, and some have pronounced it to be superior to any filler yet grown in this country. The Alabama filler leaf is considered fair, but not equal to the Texas leaf, while the filler grown in South Carolina does not meet with as much favor as that grown in the two States already mentioned.

The commercial value placed upon this leaf by different tobacco brokers varies considerably, ranging from 18 to 40 cents a pound.

Some bales of Texas leaf have been disposed of at the higher figure. Final judgment of the success of this venture must be postponed until further advices are received from the dealers and manufacturers to whom working samples have been submitted.

GROWING AND CURING CIGAR TOBACCOS IN OHIO.

Experiments in growing the Cuban type of filler have also been carried on on a 10-acre tract in Ohio. Owing to the heavy nature of the leaf it is impossible to judge of its aroma at present. The tobacco of this type raised in the preceding year is only just ready for the manufacturer. The aroma has been pronounced good, but it is believed that the leaf is too heavy for the taste of the general public and the aim this year is to try to produce a somewhat lighter leaf. The results of these experiments in growing Cuban filler leaf seem to warrant a continuation of the experiments in the Southern States and possibly in Ohio for the succeeding year upon somewhat broader lines; and it is hoped that through the efforts of the Bureau of Soils an extension of the domestic filler leaf interests may be accomplished.

By far the most important work in Ohio, however, has been the further introduction of the bulk method of fermenting cigar tobaccos. This work was begun in 1902, when 655,200 pounds were fermented. In 1903, 4,204,800 pounds were fermented, and in 1904 the quantity was increased to 10,208,000 pounds, distributed among the several

types of tobacco as follows: Zimmer Spanish, 5,850,000 pounds; Little Dutch, 582,000 pounds, and seed leaf, 3,776,000 pounds. As the work of the Department there is simply supervisory, and entails the cooperation of the warehousemen, this great increase evidences the remarkable interest that this change in the methods of handling tobacco has to the grower and the tobacco dealer. Its use not only avoids great loss formerly suffered from fungous growth in the case-fermented tobaccos, but also tends to improve the grades of tobacco and therefore increase the profits both to the grower and the handler.

WRAPPER LEAF IN CONNECTICUT.

The experiments in the production of a wrapper leaf in the Connecticut Valley have been continued during the last year. In the beginning of these experiments in 1900, work was undertaken in cooperation with the Connecticut experiment station at Poquonock, on one-third of an acre of land. The tobacco grown on this small plot was submitted to leading leaf dealers and brokers in New York for their opinion. On their judgment, which was very favorable, the Department felt justified in conducting further work in Connecticut upon a considerably larger scale. In 1901, therefore, 40 acres were planted, this time in cooperation with leading tobacco growers in the valley. This tobacco was of satisfactory quality and was sold at Hartford, and although it had been grown under very unsatisfactory climatic conditions a very good price was obtained at the sale. In 1902 a larger acreage was planted by the Connecticut farmers; and leaf dealers of New York—men who had spent their lives in the tobacco trade and who were everywhere recognized as good judges of tobacco—invested money in the production of shade-grown tobacco, not upon the reports of the Bureau of Soils, but on their own judgment of the satisfactory character of the leaf.

Owing to unfavorable climatic and adverse trade conditions, which were entirely beyond the control of the grower, the tobacco produced during that season failed, to a certain extent, to meet the demands of the manufacturers. The climatic conditions in 1903 were very similar to those in 1902—that is, they were unfavorable to the production of a wrapper leaf of the very best grade, and there was not so large a demand for this tobacco as was expected. In 1903 the Bureau had practically ceased its work in Connecticut; but in 1904, still having confidence in the opinion of the trade, and believing that the method of growing tobacco for wrappers under shade is correct, it has conducted an experiment at Tariffville, Conn., where a crop has been produced on a 4-acre plat. Owing to the recent tendency on the part of the trade to wrap the better grades of cigars with the Cuban rather than with the Sumatra style of leaf, 1 acre of this plat was planted to Cuban seed tobacco.

Tobacco of this type grown under shade in Connecticut was exhibited by the Department at the Louisiana Purchase Exposition at St. Louis, and to it was awarded the grand prize as being a leaf of the highest standard of excellence for cigar wrappers.

THE PROBLEM OF MARKET FOR FINE LEAF TOBACCOS.

In connection with this matter of the producing of shade-grown wrapper in Connecticut, the Bureau of Soils has been making an investigation as to the demands of the market for the Cuban type of leaf and as to the practicability of building up a demand for Connecticut shade-grown tobacco of this type. Recent sales of this tobacco have been made, principally in New York and Philadelphia, and the following table shows the distribution of nearly 300 bales of such tobacco and the average price per pound of the lots as sold:

Prices received for Connecticut shade-grown tobacco.

For domestic use, 134 bales:	
Bales, 17 ....per pound..	$1.75
1 ....do....	1.65
24 ....do....	1.50
3 ....do....	1.45
3 ....do....	1.40
4 ....do....	1.35
60 ....do....	1.25
1 ....do....	1.00
1 ....do....	.75
For domestic use, 134 bales—Ctd.	
Bales, 16 ....per pound..	$0.62½
4 ....do....	.35
For export, 144 bales:	
Bales, 14 ....do....	.70
30 ....do....	.32½
100 ....do....	.30
Tops, 104 bales:	
Bales, 90 ....do....	.10
14 ....do....	.08

This table shows that 134 bales have been sold for domestic use at an average price of $1.26\frac{8}{10}$ per pound, the highest price being $1.75 per pound for light wrappers, and the lowest price 35 cents per pound for short-sized second-quality leaf. The 144 bales sold for export, at an average price of $0.34\frac{4}{10}$, consisted of tobacco of a quality not suited to the home market, principally of sand leaves and short-sized, flimsy tobacco. Nearly all of this tobacco was shipped to the German market. The 104 bales, sold at an average price of $0.09\frac{7}{10}$, consisted of short top leaves, the tobacco having no wrapper quality, and being useful only as an inferior filler.

The tobacco experts of the Bureau of Soils see no reason to change their belief that the method of growing tobacco under shade in the Connecticut Valley will produce a wrapper leaf of great excellence, which can be economically used by the trade, and it would seem that the industry should be established upon a commercial scale.

IMPROVING EXPORT TOBACCOS.

Up to the beginning of last year the tobacco work of the Bureau of Soils has been along the lines of improving the methods of culture and handling of the cigar tobaccos, but this year considerable demand has

been made upon the Bureau to assist the growers of the heavy export types of tobacco. The low percentage of tobacco suitable for plug wrappers, and the poor price obtained by the majority of growers, have led the Bureau to make investigations into the production of this type of tobacco, the object being to see if both the yield per acre and the percentage of the higher grades could be increased. A 5-acre experimental plot in Appomattox County, Va., was selected for studying the problem. In this section the finest plug wrappers are grown, and the work would also be carried on close to the Richmond and Lynchburg markets. It is the plan of these experiments to grow the tobacco with different fertilizers and under different methods of culture, to see which will give the best financial results to the grower. It is the intention of the Bureau to extend this work in the future to other districts producing the shipping types of tobacco. It is yet too early to give the results of the present season's work.

BUREAU OF ENTOMOLOGY.

Insect pests cause a loss to the staple crops of the United States estimated at some $500,000,000 annually. The main object of the Bureau of Entomology is to make thorough studies of the insects responsible for these losses and to apply the information gained to limiting or preventing them. The Mexican cotton boll weevil represents the most important field of work of this Bureau during the last few years, but the insect enemies of the cereals, fruits, and other staple productions have been the subject of careful study and experimental work. The results of this work have been notably successful, particularly in the case of the boll weevil and the bollworm.

THE MEXICAN COTTON BOLL WEEVIL.

Congress originally provided $30,000 for the continuation of the investigation of the boll weevil and the bollworm for the fiscal year.

DEMONSTRATION FARMS.

Under this appropriation seven experimental farms were organized in Texas, located at Victoria, Wharton, Austin, San Antonio, Calvert, Willspoint, and Hetty, all together aggregating 558 acres of cotton. The seven localities represented typical variations in soil and climatic conditions of Texas, and enabled the Department to test various methods of controlling the boll weevil under different conditions. They included bottom lands, dry upland subject to irrigation, the black prairie land of Austin, and the soils of river valleys where the presence of timber and moist climate and almost exclusive production of cotton renders the weevil problem more serious than elsewhere. Other farms were on the high, rolling prairie land and river bottoms of the northern part of the State.

The minute investigation of the life history of the weevil, upon the knowledge of which any system of control of the pest and any modification of the present cultural system must naturally be based, was continued at the laboratory at Victoria. In the experimental fields attached to this laboratory also were tested poisons and machines. An expert assistant carried on a study of the weevil in Cuba, one of its native regions, with the hope of finding some effective parasite or some variety of cotton especially resistant to its attacks

The exact spread of the boll weevil into new cotton regions was determined, and a special investigation of the usefulness of birds in controlling the weevil was instituted. The result of the work of the season of 1903 is summarized in three important publications issued by the Bureau.

Under the provisions of the special appropriation of $250,000 made available January 15, 1904, it was possible to greatly enlarge the work.

The number of experimental or demonstration farms was increased to thirteen for the season of 1904, aggregating 1,077 acres. During the previous season in not one of the seven experimental farms then under operation did the crop fall appreciably below the average production in the United States before the weevil came into Texas, namely, about half a bale to the acre. The cultural system which these farms were designed to illustrate has so far proved to be the only practicable means of controlling the boll weevil, and the work of past years has demonstrated its general success and feasibility. It is the outgrowth of several years of field experiments conducted by the Bureau of Entomology in Texas. The cotton on these farms is planted under a contract which gives the Department complete control of the culture of the crop.

SCIENTIFIC AND LABORATORY WORK.

In addition to the conduct of these demonstration farms, the more purely scientific and laboratory work relating to the study of details of the life history of the weevil and of the possibility of artificial propagation of parasites has been increased. Special work has been done in the attempt to eradicate isolated colonies, to control the danger of dissemination of the weevil by the gins and gin products, notably cotton seed, and the perfecting of quarantine plans to check or prevent the spread of the weevil from Texas to other cotton-growing States.

COOPERATION WITH THE LOUISIANA BOLL WEEVIL COMMISSION.

The weevil having already crossed the line into Louisiana, the Bureau of Entomology has been doing cooperative work with the Louisiana boll weevil commission in eradicating colonies in Louisiana and preventing its further spread into that State, with the idea of protecting not only Louisiana but the more eastern cotton regions. The work of this year has been most successful so far as the experimental farms

and other work in Texas are concerned. It has proved impossible to exterminate the weevil in Louisiana, its distribution in the western counties of that State having become already too wide. Nevertheless its spread has been very greatly checked, and by proper quarantine and exterminative work its eastern progress can be very much delayed.

COLONIZATION OF THE GUATEMALAN ANT.

The Guatemalan ant, which was discovered by Mr. O. F. Cook, botanist in charge of investigations in tropical agriculture of the Bureau of Plant Industry, and which seems to be a very efficient enemy of the cotton-boll weevil in Guatemala, has been the subject of careful experimental work, begun under the Bureau of Plant Industry and afterwards transferred to this office, but remaining under the charge of Mr. Cook. This ant, determined by experts of the Bureau of Entomology as *Ectatomma tuberculatum*, is a tropical species of rather wide distribution throughout Central America and northern South America. Its specific habits were unknown prior to its discovery in Guatemala, but in this region, according to Mr. Cook, it seems to be an important natural enemy of the boll weevil. Nearly a hundred colonies of this ant, representing some 4,000 individuals, were conveyed to Texas, and have during the summer been placed at different points, and are being made the subject of careful study to determine whether this ant offers any hope of control to any extent of the boll weevil under the climatic conditions of Texas. The practical results of this importation can not now be foretold. The ant has, however, maintained itself during the summer, which is a feature of distinct encouragement.

THE BOLL WEEVIL STILL A MENACE.

The future work against the boll weevil in Texas and other Southern States will depend upon the action of Congress. The National menace still exists. The cotton planters of Texas have not all become convinced of the benefit to be derived by following the advice which the Bureau is enabled already to give, based upon its investigations of the past ten years, and therefore further investigation and further demonstration work seem to be necessary. Moreover, the imminent danger of the spread of the weevil to other cotton States indicates the necessity that the General Government should keep a force of men in the field to prove to the entire satisfaction of the planters the value of its advice, to continue the study of the insect in its rapidly changing environment, and to assist in quarantine measures and such other means as are necessary to restrict the spread of the pest.

THE COTTON BOLLWORM AND MINOR PESTS.

The work on this insect, which is the second worst pest of the cotton and ranges throughout the cotton belt, has been continued during the last two seasons. The work during the season of 1904 has

been much increased as a result of the special appropriation made available in January of this year. The principal lines of investigation followed out are field experiments in methods of control, and laboratory and field investigations of life history, habits, and parasitic and predaceous enemies of the insect. The field experiments have demonstrated that the cultural system of control recommended for the boll weevil furnishes the very best means also against the bollworm. The value of spraying and dusting with arsenical poisons and of trap crops was made the subject of careful experiments. This work was done on six contract farms over which the Department had absolute control, as in the case of the boll weevil, representing different localities and climatic and soil conditions. Cooperative work was also done at a number of other points, giving a total of some 400 acres on which experimental and demonstration work was carried on. The work outlined above has been most successful, and the Department is now able to recommend measures which will reduce damage from the bollworm to an inconsiderable amount.

In addition to these two principal cotton pests, other insects depredating on cotton, but of minor importance in comparison with these two, have been the subject of study.

IMPORTED BENEFICIAL INSECTS.

The possibility of keeping injurious insects in check by the introduction and encouragement of natural insect enemies of such injurious species is a very popular subject with fruit growers and farmers, and notable successes have been achieved in this direction. The work in which the Department of Agriculture has been especially interested in this direction during the year has been a continuation of the effort to establish the Asiatic ladybird enemy of the San Jose scale in the Eastern States and the South African black scale parasite in California, together with the kelep or Guatemalan ant enemy of the cotton boll weevil, referred to elsewhere.

LADYBIRD ENEMY OF SAN JOSE SCALE.

The Asiatic ladybird enemy (*Chilocorus similis*) of the San Jose scale maintained itself in numerous colonies in the South during the winter. An examination in Georgia in May last indicated the general presence of the beetle in many of the orchards where it had been liberated. Its rapid multiplication has been prevented, however, in many instances, by the submission of the orchards in question to spraying operations with lime, sulphur, and salt, or other washes, exterminating practically all of the scale food and hence leading to the starvation of many of the beetles. Nevertheless this imported insect has gained foothold and will probably make progress wherever scale food

is abundant. Its spread by artificial distribution of colonies has been continued as far as material has been available. The discovery of the efficiency of the lime, sulphur, and salt wash, and the need in commercial orchards of absolutely clean fruit, will operate against this imported insect as against all other parasites of this scale. It is a comparatively easy matter and not expensive to keep an orchard clean by spraying, and while this is the case it will not be advisable in commercial work to take the slower chance of clearing up by natural enemies, which can never be thorough from the very nature of the case. The successful establishment, however, of this Asiatic beetle in America can not work anything but good, as it is an important agency in the control of scale pests, and will become more efficient in America as it becomes more widespread and abundant.

PARASITE OF BLACK SCALE.

The black-scale parasite (*Scutellista cyanea*) in California has exceeded in usefulness the most sanguine expectations, and has demonstrated that it can withstand the winter climate of California perfectly. The black scale of which it is an enemy is the worst pest of the citrus industry in southern California, and this imported parasite is the first agency which has offered any real hope of control other than by direct spraying or gassing operations. As an illustration of the prolificacy of this parasite, more than 40,000 specimens were distributed from the office of the Los Angeles County horticultural commissioners, and vast numbers were distributed from other centers.

OLDER IMPORTATIONS.

The older importations of beneficial insects, such as the enemy of the white scale of citrous and other fruits in California and the *Rhizobius ventralis*, useful against the black scale in the moist regions of the Pacific coast, have continued their rôle of distinct usefulness, the first named being the most striking case of benefit ever made by an imported insect. The fig-fertilizing insect has enabled the raising of another very large and fine crop of Smyrna figs in the vicinity of Fresno, Cal., and the development of the fig industry seems perfectly assured, and only awaits the necessary lapse of time for new orchards to become established.

IDENTIFICATION OF SCALE INSECTS.

The work with scale insects in general has been actively prosecuted during the year. This group of insects includes some of the most important enemies of fruit trees and shrubbery, and in the South also of various field and garden crops. The small size of most of these scale insects, and the necessity of making careful microscopic preparations of them before determination can be made, render their identi-

fication by field observers difficult, if not impossible. The result is that a great deal of the work of determination comes to this Department from State entomologists and horticulturists, as well as from foreign sources.

INSECTS DAMAGING FORESTS.

The work on tree pests is carried on in cooperation between the Bureau of Entomology and the Bureau of Forestry. During the present year it has related particularly to (1) insect damage in the forests of the Black Hills region, a continuation of the work begun in 1902; (2) an investigation of important timber trees in the State of Washington, particularly the western hemlock, highland spruce, red fir, and other conifers; (3) at the southern station (Tryon, N. C.), damage to the southern pine and cypress; (4) in the middle Appalachian station, damage to imported mahogany and other timber and lumber by introduced and native insects, and to hickory, oak, and hemlock by bark-beetles and tan-bark insects; (5) at the southwestern station (Flagstaff, Ariz.), damage to pine forests by bark-beetles. In the course of this work there has been considerable cooperation with lumbering companies and manufacturers of articles of wood, importers of exotic woods, and forest rangers. The general information gained from this study and from laboratory work at Washington has greatly advanced the knowledge of forest insects and the means of controlling them.

INSECTS INJURIOUS TO VEGETABLE CROPS AND TO FRUITS.

The work reported in previous years has been continued in these two important fields of investigation. A subject of special study during the year has been the insect enemies of sugar beets, covering work done from Nebraska and Michigan to the Pacific Coast States and Arizona, with the object of issuing a comprehensive report on the subject. Work on the insect enemies of the orchard fruits, citrous and deciduous, and small fruits has been continued. The cranberry insects have been made the subject of a special publication.

MISCELLANEOUS WORK WITH INSECT PESTS.

A good deal of work has been done during the year in the study of means of controlling damage by insect enemies of stored grains, such as the flour beetles and meal worms, and particularly of the Mediterranean flour moth, one of the worst of mill pests, which has been reported during the year in many new localities, from New York to California.

Insects affecting shade trees and ornamental plants have been studied, as also the important insect enemies of hothouse plants and indoor cultures.

The investigation of insects in relation to the health of man has been continued. The geographical distribution of the yellow-fever mosquito in the United States has been the subject of special investigation, as having an important bearing upon quarantine measures.

A special study has been undertaken of rice insects in South Carolina in cooperation with the South Carolina experiment station.

INSECT ENEMIES OF GRAINS AND FORAGE PLANTS.

An elaborate investigation of insects affecting grains, grasses, and other field crops has been begun, and a special field agent of wide experience and reputation has been put in charge, with assistants and means for the best work. A further investigation will be immediately undertaken of the Hessian fly, the chinch bug, and the cutworms and wireworms and other insects affecting wheat, corn, clover, alfalfa, and similar crops. The damage by insects in this field is greater than in any other on account of the enormous areas under cultivation and the money value of the product.

EXPERIMENTAL WORK WITH INSECTICIDES.

The most important results confirmed by the experimentation of the year with insecticides relate to the use of the lime, sulphur, and salt wash against the San Jose scale. Experimentation with this wash, long used in California against this scale pest, has been going on in the East for several years, and the results now secured have fully demonstrated its very great value in spite of the somewhat adverse climatic conditions which obtain on the Atlantic seaboard and in the Mississippi Valley. It is a winter application, and very inexpensive as compared with the use of oils and soaps, means hitherto very much employed in the East, and it has the additional very distinct advantage of notable value as a fungicide; so much so in fact that some fruit growers are spraying their peach orchards with this wash, whether they have scale on them or not, simply for its value against leaf curl and other fungi. The usefulness of this wash has very largely decreased the terror which fruit growers have hitherto felt for the San Jose scale.

The possible value of sulphate of copper as a means of controlling mosquitoes, as indicated in a report issued by the office of Vegetable Pathological and Physiological Investigations of the Bureau of Plant Industry toward the close of the year, caused a series of experiments to be instituted by the Entomologist to test the usefulness of this chemical as a means of destroying such larvæ. The results of these tests have shown that it has comparatively small value against mosquito larvæ under normal outdoor conditions of breeding, but it may

prove to be quite effective against mosquitoes in regions where water is kept in cisterns or small storage reservoirs, as, for example, in Cuba and in Panama. The experimentation with this substance is still in progress.

An expert has been put in particular charge of all investigations with insecticides and machinery, and the opportunity for practical work has been very much increased. Experiments are now under way with the insecticides referred to above, and also with petroleum oils; also fumigation experiments on fruit stock and buildings and granaries, and work on the composition of insecticides in cooperation with the Bureau of Chemistry are being carried on.

ENTOMOLOGICAL EXHIBIT AT THE LOUISIANA PURCHASE EXPOSITION.

An elaborate exhibit of the work of the Bureau of Entomology was made during the year for the Louisiana Purchase Exposition—undoubtedly the most extensive and interesting exhibit ever sent out by this Bureau. It contains several entirely novel features of great educational value, and comprises very many cases indicating the life histories of injurious and other insects, together with large models of many of the principal injurious forms and vivaria in which injurious and beneficial insects are shown alive and at work.

SILK CULTURE.

The work in silk culture has been prosecuted in all available lines. Silk reeling has been practically established with imported French reels and the temporary employment of French experts. Several American women have acquired the art of reeling silk, and a beginning has been made in the training of experts in this line of work. The importation of eggs and their distribution to all applicants has been continued; also of mulberry cuttings and rooted plants.

As pointed out in my last report, the establishment of the silk industry in the United States must be a matter of slow accomplishment. The distribution of mulberry cuttings and of silkworm eggs to those who already have mulberry trees at hand should be continued. Eventually enough mulberry trees will be planted to insure a supply of food for a large crop of worms. Numbers of people will also have become familiar with the methods of silk raising, and conditions will then be ripe for the establishment of commercial filatures. In the meantime and under the existing conditions the establishment of some sort of market for cocoons is necessary; and it is for this reason that this Bureau, out of its appropriations, is buying and reeling a crop of cocoons which, though small at present, will increase as the work progresses from year to year.

BEE CULTURE.

In bee culture comparative tests have been continued with the Caucasian and other types of bees and various crosses between these types themselves, in an effort to improve the domestic hive bee and secure certain varieties of special merit for different regions. The general conclusion reached is that the Caucasian race is by far the gentlest that has ever been brought to this country, and lends itself to manipulation and handling without the use of bee veil, and generally without smoke. These bees also are excellent honey gatherers.

The frequent statements that comb honey can be artificially manufactured have been shown to be absolutely false, and the purchaser who gets his honey in the comb may rest assured that he is getting an article manipulated at least by bees.

A special investigation has been made of bee conditions over a considerable area comprising the Middle West and Western States, with the idea to familiarize the expert with the conditions in these regions and to determine the feasibility and the desirability of the importation and establishment of foreign honey-producing plants.

A model apiary of 50 or 60 colonies of bees has been secured, and it is proposed to establish it on the Arlington Experimental Farm as a basis for apiarian investigations and as a breeding station of races and types of bees. The importation of foreign queens of different races has been continued, and studies have been made of honey-producing plants, methods of wintering bees, and bee diseases.

BIOLOGICAL SURVEY.

As heretofore, the work of the Biological Survey has been conducted along the three lines laid down by Congress: (1) Investigations relating to the geographic distribution of animals and plants, including biological surveys and the determination of the life and crop belts; (2) investigations of the economic relations of birds to agriculture; (3) supervision of matters relating to game preservation and protection and the importation of foreign birds and animals.

GEOGRAPHIC DISTRIBUTION.

The Biological Survey is engaged in mapping the natural life zones and crop belts of the country for the primary purpose of aiding the farmer to decide what crops are likely to prove a commercial success in his locality. The work is done by studying the geographic distribution of native animals and plants in all parts of the country, and platting the results on maps showing the distribution of each species. In order to obtain the necessary data the status of the various species must be determined by office study and their ranges laboriously

worked out in the field. The progress already made is gratifying, and a large number of maps are now approaching completion. The individual-species maps serve as the basis of a composite map showing the natural transcontinental belts and their more important subdivisions.

During the current year field work has been carried on over wide areas in California, Texas, New Mexico, Colorado, and Alaska. In California the field operations, for the purpose of securing data for a detailed map of the life and crop zones of the State, have been continued under the personal direction of the Chief. The field parties have practically completed work in western Texas, and are now in New Mexico. Explorations in Alaska have been continued among the northern spurs of the Rocky Mountains, about the upper and middle Yukon, and on some of the islands of southeastern Alaska.

ECONOMIC ORNITHOLOGY.

In the section of economic ornithology, as in previous years, both laboratory work and field observations have been carried on. Orchards, gardens, and grain fields have been visited for the purpose of determining whether the birds damage crops, attack injurious insects, or devote their energies mainly to the wild fruits and weed seeds of the neighborhood; and collections have been made of food materials, including wild fruits, berries, seeds, and insects to assist in the work of determination in the laboratory. During the current year examinations have been made of 2,189 bird stomachs.

In studying the food habits of California birds, with reference both to the damage they inflict upon fruit and the good they do in destroying noxious weeds and insects, a scientist spent seven months (February to October) in the State, interviewing many of the fruit growers and visiting the most important fruit-growing sections. Most of his work was in the orchards, where the actual mischief done by the birds was noted and specimens collected.

In cooperation with the University of California, a study was made of the restrictive influences exercised by birds upon the increase of the well-known and very destructive codling moth. As a result, it was found that the pupæ of the moth are searched out and fed upon to a considerable extent by the black-headed grosbeak (*Zamelodia melanocephala*) and the Bullock oriole (*Icterus bullocki*)—two of the handsomest and commonest song birds of California. Other investigations were made in the same State regarding the supposed injury done by birds to bee keepers. Examinations of many stomachs of birds shot near bee-hives showed in nearly all cases that if bees are eaten at all the ones selected are the males or drones. A careful study of the food habits of the quail or bobwhite made during the year has

demonstrated beyond question that from an economic point of view it is one of the most valuable of North American birds. Some of the insect pests eaten by it are the cotton boll weevil, potato bug, chinch bug, wire-worm, cut-worms of various kinds, and the cotton bollworm.

BIRD MIGRATION.

During the year the usual spring and fall migration schedules were sent to and received from the regular observers and filed for future use. Sixteen thousand notes relating to the migration of warblers north of the Ohio and Potomac rivers were selected and arranged to complete a bulletin on North American warblers. This bulletin is now passing through the press. Work was also commenced on a study of the relations of migration and the weather by comparing the time of spring arrivals with the temperature at the place of arrival and in the region to the southward.

GAME PROTECTION AND INTRODUCTION.

ENTRY OF FOREIGN BIRDS AND ANIMALS.

Constant vigilance is necessary to prevent the introduction into the United States of birds or animals that are likely to become pests. No species, therefore, except a few that are well known and harmless, are allowed to enter this country without a special permit from the Department. And, as an additional safeguard, careful inspection is made whenever through the large size of the consignment or other cause there is any apparent danger that undesirable species may slip in. The permits issued during the year numbered 318 and allowed the entry of 1,470 mammals, 205,400 canaries, and 41,630 miscellaneous birds. Most of the canaries and a large part of the miscellaneous birds came in at New York and were examined by inspectors at that port. Several importations were made of birds intended for liberation, among them 65 capercailzie from Sweden, brought in at New York and destined for the stocking of Algonquin Park, Ontario; 40 Mexican quail, liberated at various points in California by the board of fish commissioners of that State; and 366 European song-birds—goldfinches, bullfinches, larks, and robins—turned loose in British Columbia. Permits were also issued for the entry of about 3,000 eggs of partridges and pheasants.

INTERSTATE COMMERCE IN GAME.

Since the passage of the Lacey Act in 1900, 42 convictions for illegal traffic in game have been secured in cases passing through this Department. Of these, 26 were tried in Federal courts, 16 in State courts. During the past year 10 cases, involving the shipment of 700 birds and 36 rabbits, were reported to the Department. Six convic-

tions were secured, one of which involved the longest distance shipment thus far taken up—from St. Paul, Minn., to Portland, Oreg. In order to expedite cases arising under the Lacey Act, State wardens have been advised to present their evidence direct to the Federal courts instead of referring it through this Department and the Department of Justice. This advice has been followed in two or three instances within the past few months, and indictments have been much more promptly secured in consequence.

Limited available resources have, as heretofore, made it necessary to concentrate efforts in two or three areas, and in all cases prevention of shipment has been given precedence over prosecution after shipment has occurred. The passage of laws by Texas in 1903, prohibiting sale and capture of waterfowl, made it possible for the first time to restrict the enormous destruction of ducks in that State for Northern markets. Through local authorities and express companies general attention was called to the provisions of the State and Federal laws and a close watch maintained on usual shipping routes. No violation of the law was noted, and it is probable few consignments of ducks reached Northern markets from this State during the year.

An attempt was made to ascertain the effectiveness of recent legislation prohibiting shipment and sale of game by means of a special investigation in cooperation with State wardens and others. The kinds and prices of game in the markets of a dozen or more important cities during Thanksgiving week were ascertained. That considerable progress has been made in enforcing shipping laws was conclusively shown; few prairie chickens were on sale in any Eastern markets, and in some instances prices three or four times as high as those of a few years ago were charged; pheasants were absent from the markets of several cities where they were formerly abundant; and at the opening of the season quail were unusually scarce, though later, when the routes of shipment still open were discovered by the trade, they became more abundant.

PROTECTION OF GAME IN ALASKA.

The Alaska game law has accomplished the two main objects for which it was enacted: The shipment of deer hides has been stopped and the export of heads of big game as trophies has been curtailed. The protection of game has been as satisfactory as could be expected in so large a region and without wardens. A mistaken belief, however, that the law does not permit natives to kill game for food, coupled with objections to the presence of visiting sportsmen, particularly on the Kenai Peninsula, gave rise to considerable criticism of the law. This adverse feeling led to the introduction of a bill in the Senate to replace the present law with one doing away with all restrictions except a provision to limit the export of trophies and charge license fees of $25 to residents and $250 to nonresidents for such export. As

the adjournment of Congress without definite action left this measure still pending, the Department deemed it advisable to suspend the issue of permits for the present except in very special cases. Early in June new regulations were issued extending some seasons, permitting unrestricted shipment of bearskins, and making other desirable changes.

MISCELLANEOUS WORK.

A preserve for the elk presented to the Government by Miller and Lux was established in Tulare County, Cal., on the Middle Fork of the Kaweah River, just within the boundary of the Sequoia National Park.

On the Pelican Island reservation in Florida a warden has been maintained through the cooperation of the American Ornithologists' Union and the Department, and the pelicans on the island have been practically undisturbed.

As heretofore, special attention has been given to the duty imposed by the Lacey Act of collecting and disseminating information relating to the propagation, uses, and preservation of birds. The demand for such information is widespread, and much time is devoted to gathering material and preparing it for publication.

RECOMMENDATIONS.

The three distinct lines of work assigned to this Division could be conducted much more economically and effectively were the Division reorganized as a bureau of three divisions, each to have charge of one of these lines, and were a larger amount appropriated for the performance of the work. I have accordingly recommended such reorganization.

BUREAU OF STATISTICS.

On July 1, 1903, the Division of Statistics of this Department, which is the oldest distinctively statistical agency of the Government, antedating by a score of years the creation of this Department, received the broader organization of a bureau.

As now organized the Bureau of Statistics includes a Division of Domestic Crop Reports, a Division of Foreign Markets, and a Miscellaneous Division, which conducts special investigations and collects statistics on rural economics. The work of the Division of Domestic Crop Reports forms the most conspicuous feature of the statistical work of the Department. It employs nearly two-thirds of the entire clerical force of the Bureau, and calls to its aid the public-spirited service of nearly 250,000 voluntary correspondents, whose painstaking service deserves grateful appreciation. The results of its investigations are published monthly in the Crop Reporter, of which over 1,300,000 copies were distributed during the year.

The general appreciation by the business and farming public of the value of the Department crop reports grows steadily. Criticism is not lacking. On the contrary, it is one of the curious features of this work that the more closely reports represent the actual facts and the wider the appreciation of their accuracy the more subject they become to criticism. This is undoubtedly due to the fact that as their general accuracy is more and more widely recognized they necessarily exercise a greater influence upon the markets, thus inevitably favoring or antagonizing, as the case may be, some of those who are engaged in the game of speculation in agricultural products.

This immediately attracts the adverse comments of the losers. Such a result is unavoidable, and is apparently the inevitable penalty the Department must pay for issuing reports so reliable and so generally appreciated as to have instant effect on the markets. Were the reverse true, and were these reports regarded as unreliable, they would not influence prices, and criticisms would be reduced to a minimum.

The Bureau is earnestly engaged in studying the efforts of numerous associations of cotton manufacturers organized in several European countries for the purpose of promoting the production of cotton in new lands, with a view to rendering them more or less independent of the American cotton grower. These efforts are being especially directed to the interior of Africa. Before long it is thought that the Department will be able to publish some valuable matter on this interesting subject.

The production and international movement of grain in the principal European countries is another subject which is receiving the earnest attention of the Division of Foreign Markets.

With the assistance of experts newly engaged, the rice and truck crops will for the first time be made the subjects of systematic and continuous statistical investigation. The grain belt has been redistricted and an additional field agent assigned to it.

OFFICE OF PUBLIC ROAD INQUIRIES.

Popular interest in road improvement appears to be deeper and more widespread than ever before. This is evidenced by the work of improvement actually going on in nearly all sections, by the State road legislation, by the calls for the road literature issued by the Department, and by requests for the advice and cooperation of the Department in building object-lesson roads.

COOPERATIVE FIELD WORK.

For greater convenience and efficiency in carrying on the field work of the Office of Public Road Inquiries the country has been somewhat roughly laid off into four main divisions, with a special agent in each. The work of these and other special agents in the field consists in col-

lecting and disseminating useful information regarding roads and road building, conducting investigations and experiments, attending and addressing meetings, and representing the Department in cooperative object-lesson road work.

At several points in the South the Office of Public Road Inquiries has cooperated in the construction of experimental roads of a mixture of sand and clay, and the results have shown that, in the absence of stone and gravel, this mixture may often be used to great advantage. Other object-lesson roads were constructed, with the cooperation of the Office, in Arkansas, Ohio, Tennessee, Virginia, and West Virginia. These were in most cases first-class macadam roads. An especial effort has been made to keep accurate accounts of the work done in each case, and to report the operations and expenses in such detail as to make the work a source of instruction to all who may read the reports.

Reports from all sections of the country in which experimental and object-lesson roads have been built in previous years are unanimous in commending the character of the work done and testifying to its great influence for good.

It is intended that the work of the Office shall be continued along the present lines of helpfulness and extended so far as practicable, in order that its benefits may be most widely distributed.

STATE ROAD LEGISLATION.

The most important feature in State road legislation of recent years is to be found in the adoption of the State-aid plan. This plan involves a recognition of the fact that road improvement is a matter of general as well as local interest. The inefficiency of the statute labor system of repairing roads, the unwillingness of the rural taxpayers to assume the heavy burdens necessary to the building of improved highways, the popular aversion to the issuance of bonds, and the lack of any central authority capable of coordinating the efforts of local communities, have to a great extent paralyzed efforts to secure general improvement of rural highways. The State-aid plan is intended to counteract these depressing influences. It provides sufficient funds to give scope and system to the efforts for road improvement; it distributes the burden of expense so as to greatly relieve the rural taxpayers; and it stimulates action on the part of local communities, coordinates local effort, assures competent supervision, and secures results of permanence and value.

The main features of the State-aid plan as now adopted in a number of the States are (1) a State highway commission, and (2) annual appropriations from the State treasury to pay a fixed part of the expense for building good roads, the balance of the cost to be met by the counties, the towns, and the owners of property lying along the improved

roads. In nearly all cases the initiative is with the local communities, and the work is done under local control, but according to plans and specifications which must be approved by the State highway commission.

In New Jersey, the pioneer State in the adoption of this plan, the State pays one-third of the cost and the counties two-thirds, part of the county's share being assessed against the towns, the annual State appropriation being $250,000. In New York the State provides for one-half the expense, while the counties must pay 35 per cent and the towns 15 per cent. In 1903 the legislature appropriated $600,000 as State aid. No two States have adopted exactly the same provisions. Since 1890, eleven States in all have provided for a greater or less degree of State aid. They are the six New England States, New York, New Jersey, Pennsylvania, Delaware, and Maryland. In a number of other States the plan is receiving favorable consideration.

OFFICE OF EXPERIMENT STATIONS.

PROGRESS OF THE EXPERIMENT STATIONS.

The agricultural experiment stations throughout the country are maintaining close relations with this Department and are seeking its cooperation in increasing measure. The Department is endeavoring to aid the stations so far as it can with a view to raising the general level of their work in the directions of scientific accuracy and practical usefulness and to bring the results of their experimental inquiries promptly and effectively to the attention of farmers throughout the United States. It is believed that the Federal funds given to the several States for the maintenance of agricultural experiment stations are now spent more fully for useful agricultural investigations than ever before and that the results obtained by the expenditure of these funds, combined with those contributed by a considerable number of the States, will compare very favorably in scientific thoroughness and practical effectiveness with the results obtained with equal expenditures of public funds for similar work elsewhere.

Under the system of State control of the planning and execution of the experimental operations of the State stations and under the liberal terms of the Hatch Act, through which the States are granted Federal funds for the partial maintenance of their stations, there is necessarily considerable diversity of opinion as regards the proper and wise expenditure of these funds. This fact is often overlooked in criticisms of the work of our stations as related to their use of public funds. With the growth of intelligent public opinion in the several States regarding the most useful functions of the experiment stations, the grade of their work has been raised, and when once the local constituency of a station has understood the real purpose and importance of

good agricultural investigations, there has been little difficulty in securing the adherence of the managers of that station to the spirit as well as the letter of the laws under which the station is conducted.

ADVICE AND COOPERATION FROM THE DEPARTMENT.

It has been the effort of this Department to set before the stations a high standard of efficiency and to exert steady pressure for the improvement of their work. The cases of clear departure from the law in the use of the public funds granted under the Hatch Act have been comparatively few, and in such cases this Department has insisted on such an adjustment of expenditures as would protect the Federal funds. In most instances of this kind the stations have had funds wholly subject to State authority which could be spent more freely than the Federal funds and so have easily adjusted their accounts to meet the requirements of the Hatch Act. In some cases this has not been practicable and loss of a portion of the Federal fund of the ensuing year has resulted. Not a year passes but that some stations are persuaded by this Department to forego expenditures of the Federal funds which under the terms of the Hatch Act they might technically insist they had a legal right to make but which after discussion they are convinced are not in the best interests of their work. Especially has there been effected a more liberal interpretation of the duties and responsibilities of the agricultural colleges toward the stations, which are organized as departments of research in these institutions. There are now only a few of these colleges where the narrow and short-sighted policy of dealing illiberally with the experiment stations is maintained, and this Department will not cease its efforts to bring about a change of view and action by such college authorities on this important matter.

As the amount and variety of the cooperation between the bureaus of this Department and the State experiment stations increase there arise from time to time questions of policy regarding the relations of the Department and the stations in such enterprises. To provide a regular agency for the discussion and adjustment of such matters, I have created during the past year a standing committee on cooperation, consisting of the Director of the Office of Experiment Stations and the Chiefs of the Bureaus of Plant Industry and Soils. Several conferences have already taken place between this committee and the executive committee of the Association of American Agricultural Colleges and Experiment Stations.

During the past year a movement looking to the increase of the funds granted by Congress for the use of the experiment stations has been inaugurated and legislation for this purpose is now pending. After a careful study of this matter in connection with the examination of the work and expenditures of the stations during the past two years, I am convinced that the demands on the stations for the exten-

sion of their work which have been aroused by their success in giving direct practical benefits to agriculture in all parts of the country can not be met without increased funds and that they are in a position to make effective use of larger means than they now have at their command. Now that this matter is being publicly discussed and the details of legislation have not been decided, it seems proper to state that in the view of this Department it is highly important that in any further act which Congress may pass for the benefit of the agricultural experiment stations the Federal funds shall be explicitly granted for purposes of agricultural research, and the powers and duties of this Department as related to the supervision of those funds shall be clearly defined.

STUDIES IN CHEESE MAKING.

As the work of the experiment stations advances from year to year experimental data accumulate in many lines, and from time to time results of great general importance come out of this extensive work. A good example of this at the present time is found in the investigations of the stations relating to cheese making. The importance of this in this country is shown by the fact that cheese production now amounts to 300,000,000 pounds a year, valued at approximately $30,000,000. Though cheese making is probably the oldest dairy industry, very little has been known regarding the principles on which it is based. For centuries it has been carried on largely by rule-of-thumb methods, and the reasons for the various processes and the exact nature of the changes brought about by them have been unknown to the cheese maker. He has been guided mainly by the traditions of his art and has depended upon the skill and judgment acquired through long experience.

Within the past ten years several of the experiment stations of this country have prosecuted systematic studies of cheese making with a view of determining the principles upon which it rests and the means of simplifying and improving its processes. Owing to the large number of factors involved the work has been difficult, and for a considerable time the progress was slow. Now, however, the accumulated results are of great practical value, and it may be fairly claimed not only that this great industry has been put on a rational basis, but also that the art of cheese making has been simplified and its processes can now be more easily controlled, so that good cheese can be more uniformly produced.

GAINS IN USE OF FEEDING STUFFS.

The Office of Experiment Stations has recently published a summary of a large amount of work which the stations have done on questions relating to feeding stuffs. Some of the practical results of this work have been very important. The saving and use of corn fodder

(stover), which was formerly so largely wasted over a large part of the country, is a striking illustration of this. Its value as a feeding stuff has been demonstrated, and the best means of utilizing it have been shown by the stations' work, and their continual agitation has brought about very great improvement in farm practice in this respect. At the nominal value of $1 a ton the corn stover crop of the United States would be worth at least $100,000,000. While it is not all utilized, much the larger share of it is, and the practice of doing this is steadily increasing.

The inspection of commercial and condimental feeding stuffs, brought about by the experiment stations, has already had the effect of largely holding in check the adulteration of these products and fraud in their sale. In a number of the States where the laws have been vigorously enforced by the stations inferior articles have been entirely driven out of the market, because farmers would not buy them unless they received the stations' stamp of approval.

THE AGRICULTURAL COLLEGES.

The activity of the colleges in providing special buildings and laboratories for instruction in the different divisions of the science of agriculture continues unabated. Among the buildings of this nature recently completed are the $50,000 agricultural building in South Carolina, the $150,000 agricultural building of the University of Wisconsin, and the agronomy and animal husbandry judging pavilion and the farm mechanics building of the Iowa State College of Agriculture and the Mechanic Arts. The University of Nebraska is erecting a $60,000 building for its school of agriculture.

The appropriations of the year for new buildings at the colleges and for the maintenance of these institutions have also been very large. The State legislature of Virginia appropriated $165,000 for buildings, equipment, and improvements at the agricultural college. The Iowa college has an addition of $50,000 to its maintenance fund, an appropriation of $95,000 to complete the central building, $45,000 for a dairy building, and $10,000 for equipping it, $22,000 for a new dairy farm, and $7,000 for equipment, and $54,500 to begin the construction of a heating plant, with several minor items, including $15,000 annually for the experiment station. The College of Agriculture of Cornell University is now definitely organized under State support, with an appropriation of $250,000 for buildings and equipment. The Illinois College of Agriculture has appropriations for a building for beef cattle, $25,000; another for horticulture, $12,200, and for a storage building for agronomy, $12,500. Minnesota has appropriations aggregating $300,000 for building purposes, including, among other items, $218,000 for a main agricultural building.

STUDY OF RURAL ENGINEERING AND FARM MACHINERY.

There is increasing interest in the formulation of courses in rural engineering and the provision of special facilities for instruction in this important subject. Special attention is being given to instruction relating to the construction and use of farm machinery. The continued scarcity of farm labor in almost all of the agricultural regions in this country makes necessary the employment of farm machinery on even a more extensive scale than has hitherto prevailed. The total value of implements and machinery on farms in this country, according to the last census, was $761,261,500, an average of $133 per farm and of 90 cents per acre of farm land. Much of this machinery is elaborate and complicated in construction and requires mechanical skill and genius for its most efficient operation and care. In very many cases it is also essential that the farmer shall understand how to repair such machinery. It represents an important part of the farmer's invested capital upon which he must earn or pay interest. That there is an enormous waste of money due to neglect and unskillful handling of this part of the farm equipment must be obvious to any one who has traveled through the regions where it is most used. The colleges can therefore do a very important work in training their students so that they will understand the construction, care, and most economical use of farm machinery.

ATTENDANCE, AND EXPOSITION EXHIBIT.

The attendance at the land-grant colleges in 1903 aggregated 52,489 students, of whom 3,146 were in four-year courses in agriculture, and 7,550 in shorter courses in agriculture, dairying, horticulture, and veterinary science. The graduates of these institutions in 1903 were 4,524, and since their organization 53,252. The importance of the colleges of agriculture and mechanic arts as a part of the American system of higher education and research has been notably shown during the past year at the Louisiana Purchase Exposition, where an extensive exhibit of the work of these institutions was made in the Palace of Education.

SECONDARY AND ELEMENTARY SCHOOLS.

Progress has been made during the year along the lines of secondary instruction in agriculture not only in the schools maintained in connection with the agricultural colleges, but also in separate secondary schools, the number of which is steadily increasing. Considerable attention is being given of late to the practical instruction of women along agricultural and horticultural lines.

The introduction of agricultural instruction into the primary schools

is being more widely discussed than ever before at meetings of teachers and farmers. The success of the nature study and school garden movement in a considerable number of city and country schools has led to a demand for the more formal teaching of elementary agriculture in the higher grades of the rural schools. The National Educational Association, State superintendents of public instruction, officers of agricultural colleges, as well as a number of other organizations and numerous individuals in various official positions, have of late interested themselves in the introduction of elementary agriculture and gardening in these schools. The National Educational Association now has a special committee of educators of national repute considering this subject.

METHODS AND TEXT-BOOKS.

At the recent convention of the Association of American Agricultural Colleges and Experiment Stations at Des Moines, Iowa, the standing committee on methods of teaching agriculture made a report in which it gave a brief history of the development of manual training and agricultural instruction in the common schools, and outlined a course of nature study and elementary agriculture for such schools. Outline courses in elementary agriculture have already been prepared by school officers in a number of States. These are supplemented by the formation of clubs of farmers' boys and girls, which are organized for the purpose of conducting simple experiments at their homes. Eight thousand Illinois boys belonging to these clubs exhibited corn of their own raising at the Louisiana Purchase Exposition. In a number of States laws have been enacted requiring teachers to pass examinations in agriculture, and the training of teachers along agricultural lines is already receiving considerable attention at agricultural colleges and schools, and normal schools, especially at sessions held during the summer. A considerable impetus to the movement for the introduction of agriculture in the public schools has been given by the recent improvement of text-books and works of reference. Within the last year or two a number of elementary text-books in agriculture have been published, and some of these seem well suited to use in the rural schools. In one way or another thousands of children in the common schools are already receiving some instruction relating to agriculture, and the movement in this direction is rapidly increasing.

AID FROM THE DEPARTMENT.

This Department is aiding this movement so far as it can without having funds specifically for this purpose. It seems very desirable that the Department should be in a position to give more effective aid to the movement which contemplates the application of the results of practical and scientific investigations to our agriculture through instruction to multitudes of farmers' children in the public schools as

well as in the agricultural colleges. The vast majority of teachers in rural schools throughout the country are unacquainted with the work and publications of this Department and do not understand how these publications might be utilized for instruction in subjects related to agriculture. Very much needs to be done to overcome the prejudice of school officers and teachers against the introduction of agricultural subjects into the schools. It is becoming increasingly clear that the results of the work of this Department and the experiment stations can not be most effectively and widely utilized by our farmers unless in early life they are taught to think and act along the lines in which the application of scientific principles and discoveries is made to appear theoretically rational as well as practically useful. Therefore, to secure the greatest benefit to our agricultural people through the expenditure of public funds in the maintenance of this Department and the experiment stations, we should be able to bring the work of these institutions directly to the attention of our educators and school managers in every State and Territory.

FARMERS' INSTITUTES.

Work in the interests of the farmers' institutes throughout the country has been regularly organized in the Office of Experiment Stations. Special efforts are being made to aid the large force of lecturers who are in the employ of the State directors of institutes. The attention of these lecturers has been definitely called to the numerous publications which this Department and the experiment stations are issuing, which will be useful to them in their institute work, and they have been put in the way of receiving these publications regularly.

There is also a growing movement for the establishment of the institutes in the several States on a more permanent basis. The form of organization most approved is that of a strong local permanent organization in each institute district, combined with a system of oversight and limited control by the central State authority, whose duties and powers are prescribed by law.

ALASKA EXPERIMENT STATIONS.

During the past year experiment stations were maintained at Sitka, Kenai, Rampart, and Copper Center, and cooperative experiments were conducted at Wood Island. Seeds of vegetables and flowers were distributed through the cooperation of the Bureau of Plant Industry to about 1,500 addresses. Many of the recipients report success and further confirm the possibility of raising hardy vegetables and hardy annual flowers in nearly all parts of the Territory south of the Arctic Circle. An investigation of the grasses and forage plants of Alaska is being conducted in connection with the Bureau of Plant Industry. At

Sitka the headquarters building has been completed in accordance with the plans furnished by this Department, except for some minor alterations made in the interests of economy. More attention will hereafter be given at this station to horticulture and the propagation of trees and bushes for distribution to the other stations and over the Territory at large. Some nursery stock consisting of hardy and early maturing varieties of apples, plums, and cherries have been planted, and currants, gooseberries, and raspberries are also being propagated.

SOME RESULTS OF THE WORK AT THE STATIONS.

At the Kenai station about 21 acres have been brought under cultivation. Experience during the past two seasons at this point has shown that the maturing of grain is somewhat uncertain, though an abundance of forage can be grown every year. Cattle do well here, and the station is beginning in a small way to build up a herd.

At the Copper River Valley station, opened two years ago, a number of acres have been cleared and cultivated. During the season of 1903 barley and oats matured, and produced plump and heavy grain. Cultivated grasses seeded in experimental plats did well, and a considerable variety of hardy vegetables were grown. In 1904 an elaborate system of plants has been laid out and extensive experiments are under way with cereals. During August a severe frost destroyed many varieties of the cereals, rendering them fit only for hay, but some barley was matured and the grain saved for seed, and about 90 per cent of the Sixty Day and Finnish Black oats were matured, making about an average crop. This station has the first equipment of farm implements brought into the interior of Alaska. A number of small tracts have been cleared by settlers and are under cultivation at various points throughout the valley.

At the Rampart station grain matured in 1902 and 1903, and for this reason more extensive experiments have been conducted during the past year, and barley, oats, and rye have been successfully grown.

In general the experimental work in Alaska has shown that live stock may be successfully maintained at many points in the Territory. The special agent in charge of the Alaska stations urges the desirability of securing breeds of sheep and cattle better adapted to the climate of Alaska than those which have hitherto been maintained there. It is, however, impracticable to carry on experiments with animals in any large way with the funds now at the disposal of the stations.

GRASS LANDS AND LIVE STOCK.

There are on the southern coast of Alaska, from Cook Inlet to Unalaska, about 10,000 square miles of grass lands, over one-half of which are capable of utilization. On much of this land there is a lux-

uriant growth of grasses often 6 feet high; on the remainder, lying at higher elevations and in more exposed situations, the grasses are too short for hay cutting, but furnish splendid pasturage. That these grasses are nutritious the fat and sleek condition of the cattle furnishes ocular demonstration.

At the present time this great resource is practically untouched, though there are small herds of milch cows at most of the towns and villages. Recently a live-stock company has begun operations with cattle and sheep on Kadiak Island and another company is making actual preparations to utilize Akutan Island.

It is possible for both sheep and cattle to live throughout the winter without care, as has often been demonstrated. Indeed, where cows belong to the natives they are forced to live through the winter with little or no care, eking out an existence by feeding on browse and seaweeds. Milch cows kept by whites are as a rule fed from five to six months, and this may fairly be considered the length of time when animals require feed and shelter.

Sheep raising has thus far not proved successful. The principal trouble seems to have been that the animals were of breeds not adapted to the conditions that prevail on the Alaska coast. In both cases where trials have been made grade animals were imported from the semiarid regions of California and Oregon, where the climate is well-nigh the antithesis of that in Alaska. With other breeds success is not at all unlikely to follow.

For three reasons I am impelled to believe that the Alaska grass lands as a whole can be most profitably utilized at present through dairying. First, because the small population of the Alaska coast limits the market for beef to a small fraction of the possible yield. Second, because of the necessarily long feeding period, five or six months, during which only dairy cattle will yield compensating returns. Third, because the freight to distant markets on concentrated products like butter and cheese is not a serious factor.

The Alaska coast furnishes many admirable sites for dairy colonies or settlements, both on the islands and on the mainland. With such a great wealth of grass as southwestern Alaska possesses it is difficult to believe that it will not become a great dairy country. It is doubtful if equally good opportunities for colonies of dairymen can be found in the United States to-day. Certainly there is no other place left where 320-acre homesteads of magnificent grass lands can be had for the taking. In view of the enormous area of these lands, it seems most advisable that this undeveloped resource be converted into wealth. Perhaps nothing will stimulate this as much as practical experiments and demonstrations by the Department of Agriculture.

HAWAII EXPERIMENT STATION.

A chemist and horticulturist have been added to the staff of the Hawaii station, and in this way the field of operations has been considerably widened. Soil investigations have been undertaken by the chemist, which are of general importance to the agriculture of the islands. The horticulturist has prepared a bulletin on bananas, which not only treats of the cultivation and marketing of this fruit, but also brings together descriptions of a large number of Hawaiian varieties, making possible a systematic study of this important food plant. Experiments are being continued on the cultivation and fertilization of bananas, and a large collection of varieties is being brought together on the station grounds. Experiments in the propagation of mangoes and alligator pears have been begun.

The entomologist has prepared a bulletin on the leaf hopper of sugar cane, which was investigated at the solicitation of many of the planters of the islands. This insect made its appearance quite recently and has proved in certain districts to be a very serious enemy to cane cultivation. The bulletin treats of the life history of the pest, describes the injury produced, and offers suggestions for its control.

Under the immediate direction of the special agent in charge, investigations have been made of some of the fungous diseases of coffee, sugar cane, and other economic plants, and a comparative test of grasses and forage plants has been begun in connection with the Hawaii Live Stock Breeders' Association. Cooperative experiments with tobacco have been conducted on the island of Hawaii with the object of producing a type of tobacco that is especially adapted to Hawaiian conditions. Cooperative experiments on cacao and banana cultivation are also being carried on in connection with the insular board of agriculture and the Hilo boarding school.

PORTO RICO EXPERIMENT STATION.

The work of the Porto Rico experiment station has been considerably enlarged during the past year, partly with the aid of an appropriation of $2,700 made by the insular legislature and nearly $1,200 received from the sale of farm products.

Many permanent improvements have been made on the station farm. A small tile machine was purchased and drain pipes were manufactured on the farm. Practically all the river bottom or alluvial land on the station farm has been drained. This is the first underdrainage ever undertaken in Porto Rico, and it is believed that it will not only greatly enhance the producing power of the station property, but will also serve as a valuable object lesson to the planters of the island. An experimental irrigation system has also been installed on this farm.

A preliminary survey of the principal tobacco districts of the island has been made by a tobacco specialist in the employ of the station, and a report on these investigations is being prepared.

The investigations on different methods of pruning, shading, and fertilizing coffee plants have been continued. An attempt to exterminate the coffee-leaf miner by hand picking the leaves proved the impracticability of this method of repressing this pest. The entomologist of the station has also been investigating the possibility of combating this insect by means of parasites, and reports the discovery of an effective parasite which, it is believed, by careful propagation and distribution, will aid very materially in keeping in check this insect, which is by far the most serious enemy to coffee cultivation now upon the island.

A special study of the diseases of coffee and other plants was made by the botanist of the Connecticut State experiment station, who was temporarily in the employ of the Porto Rico station.

Much attention is being given to the propagation of citrous fruits, especially with a view of obtaining better stock for growing in the orchards of Porto Rico. A bulletin on the methods of production and marketing of oranges, with special reference to Porto Rico conditions, has recently been issued. A large number of tropical fruits, including mango, alligator pear, soursop, nispero, guava, and many others, have been brought together in a tropical fruit orchard.

The tea, rubber, and cacao plantations mentioned in my last report are flourishing and are being extended. Among the tropical vegetables which enter into the variety tests are the yautia, taro, edible canna, arrowroot, cassava, yams, and sweet potatoes, all of which have thus far done well.

Experiments are being carried on with a number of fiber plants. Among these, maguey and sisal have thus far given very promising results. The station has thus far conducted no careful experiments with cotton, but the industry has been extended throughout the island to a considerable extent during the past year, and the station officers report that the results seem to indicate that it is possible to profitably produce a medium grade of Sea Island cotton in Porto Rico.

The report of the Bureau of Soils on the soil survey from Arecibo to Ponce, made by that Bureau in cooperation with the Porto Rico station, has been reprinted in both English and Spanish for distribution on the island. Several other bulletins and circulars in both languages have been issued during the year.

PROPOSED EXPERIMENT STATION AT GUAM.

This Department has recently received a request from the governor of Guam for the establishment of an agricultural experiment station on that island. In making this request the governor states that the

population of the island, consisting of about 11,000 people, and increasing at the rate of about 3 per cent a year since the American occupation, is devoted entirely to agriculture. The farms, which are small, are located in the hills back of the surrounding towns, and the people usually go to them in the early morning, returning to their domiciles at night. As they are devoted to tilling the ground and the raising of fruits, and to nothing else, this is an especially good field for the introduction of such additional fruits and vegetables as only the resources of the Government can command. The revenues of the island are insignificant, so that the people can not afford to pay anything toward an experiment station, although its influence will be very beneficial. There is a considerable tract in the public lands of the island which could be set aside for an experimental farm.

Since it seems quite important that the people of Guam should receive such aid in developing their agriculture as is now given by the Government to our other island possessions, I have recommended an appropriation of $5,000 for the maintenance of a station on this island in cooperation with the Navy Department.

NUTRITION INVESTIGATIONS.

In the nutrition investigations steady progress has been made in the elaborate and fundamental inquiries regarding the laws of human nutrition with the respiration calorimeter, and in the more directly practical studies of the nutritive value of cereals, fruits, and meat. The great importance of these investigations is being recognized, not only by scientific and educational institutions throughout this country, but also in many foreign countries. The constantly increasing number of requests for nutrition publications and for information from individuals, institutions, public schools, medical schools, and similar sources, is a proof that the results of the nutrition investigations excite wide interest and are appreciated.

The cooperative method by which the work of investigation has been distributed among various educational, scientific, and similar institutions in the United States has been productive of as excellent results the past year as hitherto, and a satisfactory amount of investigation has been conducted. This has been made possible in part by the generous support accorded by the cooperating institutions, which have contributed in some cases money, and in practically all cases the use of laboratories, apparatus, libraries, the advice and counsel of skilled experts, and similar assistance. Other institutions have expressed a readiness to join in such researches, provided a comparatively small amount can be allotted them, but with the funds at our command it has not been found possible to extend the inquiry beyond the present limits.

CALORIMETER EXPERIMENTS.

The experiments with the respiration calorimeter during the past year have had to do principally with the comparative values of fat and carbohydrates as sources of energy. The apparatus has been so modified that a given quantity of air is circulated through the respiration chamber, the oxygen withdrawn by the subject being made good by the addition of a fresh supply, while the products of respiration are removed for measurement and analysis. This method of experimenting permits of direct measurements of the oxygen consumption in addition to other factors concerned with the metabolism of matter and energy, and represents a decided advance. In its present form the apparatus is fully as accurate as the form previously described and gives very satisfactory results. The form of apparatus which may be most advantageously used depends upon the character of the problem which is to be studied, since both the earlier type, in which a continuous quantity of air was pumped through the apparatus, and the present type, with the closed air circuit, furnish very accurate means of studying a large variety of problems which have to do with the fundamental laws of nutrition and practical questions connected with the satisfactory feeding of man and domestic animals.

SPECIAL STUDIES OF THE YEAR.

During the year the experimental and editorial work connected with the dietary studies at the Government Hospital for the Insane has been completed and a bulletin describing the results in detail has just been published. The data secured are of great interest in themselves and will prove of material assistance in formulating dietary standards and in other ways, while the experience gained in conducting investigations will prove of great value in future work of a similar character. The studies showed that the diet at the Government hospital was well managed and that the food was abundant, of good quality, and well prepared. As the study progressed it became evident that in many ways economy in the preparation, handling, and storing of food might be introduced which would prevent waste and effect a considerable saving without making any radical change in the character of the menu. In other words, it was evident that, as in all business enterprises, more careful and expert management would prove valuable.

The studies concerned with the nutritive value and digestibility of flours of different grades have furnished very interesting data and the material now accumulated seems sufficient for answering the much-discussed question as to the comparative value of different sorts of flour ground from a given lot of wheat. It seems fair to say that the grades of flour known as whole wheat and graham contain a somewhat

larger proportion of protein and ash than the patent grades, but are inferior as regards the thoroughness with which they are digested. Judging, therefore, by the total material which the body receives, the various sorts of flour are practically equal in value. The mechanical effect which the coarser flours exercise on the digestive tract should not be overlooked.

The dietary studies and digestion experiments with Maine lumbermen have given some interesting and valuable results. In fixing upon dietary standards it was desirable to have data regarding the kinds and amounts of food consumed by persons performing severe work and leading a very active outdoor life. Such conditions were met in the Maine woods. The diet with which the lumbermen were provided was comparatively simple in character though generous in amount. Generally speaking, the quantities eaten were fairly large, furnishing an abundance of both protein and energy. The food was quite thoroughly digested, no difference being observed between these men and those living and working under more usual conditions.

At the University of California, the investigations concerning the nutritive value, digestibility, and place in the diet of fruits and nuts have been continued and important data are being accumulated. The bulletins already published, which report the results of these investigations, have been widely circulated, showing that there is a popular demand for information along these lines. A popular bulletin has been published showing how a surplus fruit supply may be used in the household for the preparation of jams, jellies, and similar products, a class of foods which may be made to supply carbohydrate material in a palatable and attractive form, while at the same time the acids and other bodies which the fruits contain are believed to exercise a beneficial effect on the system.

IRRIGATION AND DRAINAGE INVESTIGATIONS.

METHODS AND PROBLEMS.

During the past year the office of Irrigation and Drainage Investigations made a comprehensive study of the methods and cost of preparing land for irrigation. The results show the need of a better understanding of this subject by farmers. Much has been done by the Government and the States to aid engineers in the right planning of dams and canals, but farmers have not been aided in like measure in understanding how to get the best results out of the water when furnished. A bulletin published by the Department gives descriptions and illustrations of the tools used in grading land and building laterals and of the leading systems in use in distributing water in fields, orchards, and gardens. These studies show that the cost of preparing land for irrigation is far greater than has been realized, varying under

flooding from $2 to $5 an acre and under the check system from $8 to $25 an acre. Here is a large opportunity for saving money to farmers by aiding them in choosing the method best suited to their conditions.

Last year a working agreement was entered into with the Western experiment stations for the systematic collection of information on important features of irrigation practice, which will enable this Department promptly and at small cost to collect and disseminate information of great practical value. This year the subjects studied were the methods of measuring water, the rate of rise of soil water during the irrigation period, and the use of cement and concrete instead of wood in irrigation structures.

DUTY OF WATER AND APPLICATION TO SOIL.

The increasing value of water has given added importance to the studies of its duty, which have been a leading feature of this investigation from the outset. Rights which originally were purchased for $5 an acre now sell for $35 an acre. Annual water rentals have risen in certain districts from $1 to $7 an acre. Every extravagant appropriation of water is a direct incentive to waste, and excess contracts and decrees will continue to be made so long as the quantity actually used has not been determined by accurate impartial measurements. This fact is giving the work of the Department increasing importance. Its reports are being used in fixing water-right decrees, and measurements of the duty of water on streams where adjudications are proposed are urgently requested.

Scarcity of water in the arid West makes it desirable that it shall be used by irrigators in the most economical and skillful way. To aid in making this possible the Department is carrying on a series of scientific studies to determine the quantity of water which will give the best results and the best method of applying it to crops. In one important irrigated district these measurements show that the quantity needed to irrigate 60 acres of land under the method in common use will irrigate 100 acres when applied by another equally feasible method. They also show that the time of irrigation and the quantity of water used have an important influence on the quality as well as on the yield of crops.

PUMPING WATER FOR CROPS.

During the past season records of the performance of over 2,000 irrigating pumping plants, scattered from Texas to Washington, have been obtained. These included many types of pumps operated by gasoline, crude oil, distillate, by steam generated by means of oil, coal, and wood, by electric motors, windmills, and water power. The rapid extension of pumping as a means of extending irrigation gives great practical importance to these studies.

Wind is one of the neglected but promising sources of power for providing water for irrigation and for doing other farm work. An arrangement has been made with the department of farm mechanics in the Iowa State College to supplement the field studies made during the year by more careful tests of the efficiency of different makes of windmills. The makers of these machines have manifested much interest in these investigations and have not only offered to supply the mills needed for testing free of cost but to manufacture others according to any special design suggested by this Department.

Last season's pumping studies lead to the conclusion that there is a broad field for irrigation by pumping; that where the lift of water is less than 50 feet the number of failures are comparatively few. The failures noted have been due to two principal causes: Lack of mechanical knowledge or skill on the part of farmers needed to keep machinery in proper condition; and the selection of pumps of too great or too small capacity for the work to be done.

IRRIGATION IN THE HUMID SECTIONS OF THE UNITED STATES.

The studies of irrigation in Italy show that irrigation is highly profitable in a region having a larger rainfall than the Mississippi Valley, and there seems no doubt that in a similar way it is to have a large field of usefulness in the eastern and southern portions of the United States. One of the special crops which require irrigation is cranberries, and a cooperative arrangement has been made with the experiment station of Wisconsin and the Wisconsin Cranberry Growers' Association, under which the Department is attempting to formulate the principles which should govern the irrigation and drainage of cranberry beds. The studies made in Wisconsin are being supplemented by similar studies in New Jersey.

In the rice districts of Louisiana and Texas practically all the water used in irrigation has to be pumped. The quantity used and the performance of different types of pumps in providing it are controlling factors in the success of this industry. Both these have been studied during the past year.

There is a large territory in central Arkansas which is believed to be well suited to rice growing. The Department is cooperating with the State experiment station to ascertain whether it will pay in this section to pump water to irrigate rice. The results this year, while encouraging, show that it will require considerable experimental work to place the industry on an assured basis.

DRAINAGE INVESTIGATIONS.

Crop production is being extended in this country in three ways—(1) by reclaiming, through irrigation and drainage, lands hitherto worthless or yielding only a nominal return; (2) by improving soil

conditions in lands already under cultivation; (3) by scientific rotation and intensive cultivation of crops.

Since soil drainage is an important factor in all of these, the promotion of practical and efficient methods may do much for the general improvement of agriculture. Original investigation, combined with careful scrutiny of current practice in this and other countries, will enable this Department to place before State and district authorities, cultivators, and landowners the methods and practices suited to their conditions.

The following work was carried on during the year:

(1) An examination of some of the irrigated lands of Utah for which drainage is urgently needed, the giving of advice concerning plans, and the beginning of some experiments in tile drainage to determine the operation of underdrains in certain soils.

(2) The examination of several large drainage projects in the Middle West, in company with engineers, county boards, and interested landowners, followed by reports and recommendations of plans. About 400,000 acres of land are affected by these projects, with an estimated outlay for drainage of $1,000,000.

(3) Collecting and classifying field data upon the construction of levees for protection of river bottom lands; their ditching and drainage by pumps; construction, duty, and operation of land dredges; the construction and behavior of drainage ditches of various sizes.

(4) Collection of data regarding the operation of the older systems of tile drainage in the Middle West, with respect to determining how far conditions may be improved by reconstruction.

A preliminary examination of a portion of the Everglades in Dade County, Fla., was made in conjunction with the Bureau of Plant Industry, and it is thought that the Everglade soil can be made profitable for growing subtropical fruits if it can be sufficiently drained. In view of the interest taken in growing fruit and vegetables in southern Florida for the Northern winter markets, the reclamation of the Everglades merits further attention.

The lines of work carried on during the present year indicate the widening importance of this branch of agricultural improvement. The condition of much of the farming land in the older irrigated districts, and especially in Utah, demands prompt and active relief through drainage, or the loss already suffered by bogging of the land will be rapidly augmented. The Department can render great assistance to the people of these sections by enabling experts to direct and assist in starting practical drainage operations in localities where farmers are ready to begin.

An entirely different class of problems has been encountered in connection with the drainage of the peat swamp lands of central Wisconsin. Here the assistance of the experts of the Department has been

requested in order to determine the manner in which drainage should be accomplished and regulated during the subsequent treatment of these marshes.

The reclamation of tidal marshes is a subject upon which numerous inquiries have been received and which may be profitably studied.

The further development of the prairie lands of Arkansas and the heavy cotton lands of Mississippi will depend upon the introduction of more thorough methods of drainage. There is no public information available bearing directly on the treatment of the drainage problems there encountered, although it is a fundamental matter in the development of certain lands in these States.

The drainage experts of the Department have given considerable time and thought in advising with and aiding agricultural colleges and stations about courses of instruction in drainage engineering and the carrying out of experiments in drainage. The establishment of these courses of study and the special training of men to carry out this branch of farm improvement promise much for the betterment of soil conditions and soil production in future years. The success of these classes is shown by the fact that Illinois has 42 and Iowa 65 students at present enrolled in drainage engineering.

AGRICULTURAL ENGINEERING.

The valuable results which have come from including irrigation and drainage in the work of the Department leads me to believe that this investigation should include two other branches of agricultural engineering with which they have a close relation. These are farm buildings and farm machinery.

That this Department should give some attention to the convenience and healthfulness of farmhouses and farm buildings would not seem to require any argument. These have such vital relation to the attractiveness and profits of farming and to the improvement of the social and industrial conditions of farm life that they ought not to be ignored by this Department.

There is urgent need of study of the important question of ventilation and lighting in farm barns. A recent investigation carried on by the Agricultural College of Wisconsin has shown that scores of costly barns, intended to house valuable blooded live stock, and on which thousands of dollars have been expended to secure perfect sanitary conditions, are a complete failure so far as ventilation is concerned; and that this lack of proper ventilation is causing serious increase in the spread of tuberculosis and seriously impairs the profits of feeding. Hundreds of farmers are delaying the building of barns because, while they realize the nature of the difficulty and the necessity for its remedy, they do not know how to accomplish it. It is a striking but admitted fact that we are so ignorant of the proper principles of barn ventila-

tion that many of the costliest structures built in recent years have been the most defective in this regard.

There is another reason for this Department giving some attention to the subject of farm buildings. We are entering a transition period in which the cheap wood construction of former years is giving way to permanent structures of stone, concrete, and iron. Farm houses, through better water supplies, plumbing, and sanitation, are being made as convenient as those of the city. The working out of these changes involves so many new problems that the Department is being called upon by experiment stations, improvement associations, and communities for advice and information which if furnished could not but result in a marked improvement in the conditions of farm life.

MACHINERY AND MOTIVE POWER.

Closely related to the healthfulness, convenience, and cheapness of farm buildings is the right selection, care, and use of farm machinery. The studies of pumping machinery have shown that the most important factor in its successful use is the mechanical skill of the farmer, and we are beginning to understand that the increased complexity and cost of farm machinery make the education of the American farmer along these lines more and more desirable.

No more significant change is taking place in American agriculture than the extent to which different kinds of motive power are taking the place of men and animals. The use of the traction engine and automobile in the place of the horse on the country roads, the employment of gasoline, steam, wind, and electric power to operate mowers, threshers, plows, feed cutters, corn huskers, and dairy machinery are illustrations of epoch-making changes that are now going on on every modern American farm. On one ranch in California there is $60,000 worth of farm machinery operated by some other power than animals or man. For want of proper information these changes are involving farmers in serious mistakes and large losses. They buy motors not suited to their requirements or which they do not know how to operate. They buy machinery not adapted to their condition and cause its rapid destruction by not knowing how to care for it.

There is made and sold each year in this country about $100,000,000 worth of farm machinery. Fully one-half of this goes into the hands of men who do not know how to select it wisely or to keep it in proper condition. The waste which results runs into millions of dollars annually. In addition, implement manufacturers lose large sums in making and attempting to introduce machinery unsuited to the work it is intended to perform, with a resultant loss to both farmers and manufacturers.

Realizing the need of improvement in these matters, and partly to meet the requests of implement manufacturers for young men having

agricultural and mechanical training which will enable them to design and construct implements suited to the conditions of the American farm, a number of agricultural colleges and experiment stations have inaugurated courses of instruction and begun systematic experimentation for the purpose of bringing about a general diffusion of intelligence about this feature of farm work. They have appealed to this Department for aid in this work similar to that already given them in other lines of agricultural investigation.

TESTS OF CORN PLANTERS AND WINDMILLS.

As illustrating the important results which are destined to come from the inauguration of this work, one of the results of an investigation carried out by the Iowa State College, a pioneer in this line of education and experimentation, will be given. It began its study of farm machinery with the operation of corn planters, because no single factor contributes more to the yield than securing a uniform stand, and this is impossible if the seed is not planted evenly. The machines for planting corn in hills are intended to drop from three to four grains, yet farmers have been buying, and implement makers manufacturing and selling, planters without any definite knowledge as to how they behave in this respect. In making this test all of the leading machines were included. It brought out the following significant facts:

(1) That no planter now made will drop evenly unless the grains have been graded. The introduction of seed-grain graders followed, and was an immediate, important, practical gain to agriculture and to manufacturers of this kind of machinery.

(2) That with graded grain certain types of machines do accurate work.

(3) That other types will not drop evenly under any conditions.

The important and encouraging feature of this investigation has been the interest shown by manufacturers who have accepted the results as impartial and conclusive. Makers of machines found defective were as ready to accept the results as the makers of those which operated properly, the defects being at once corrected.

The test of windmills by the Iowa State College to determine the designs and sizes best suited to lifting water for irrigation promises to lead to important results in extending the use of this motive power in grinding grain, handling and storing produce, and doing some other kinds of farm work practically without expense, which formerly required a considerable expenditure for man or animal power.

NEED OF AN EXPERT IN FARM BUILDINGS AND MACHINERY.

The requests of the colleges and stations for aid in carrying out these investigations and in planning courses of instruction have been supplemented by numerous similar requests from farmers for advice

and assistance about the selection and operation of different kinds of farm motors and other farm machinery. In the absence of any special arrangement for dealing with these problems, they have been referred to the Office of Experiment Stations and dealt with by the Irrigation and Drainage division of that Office; but there are at present no funds which can be utilized for systematic work along these lines. I am of the opinion that results of great value, alike to the farmers and the manufacturers of agricultural machinery, will come from the extension of the Department's work in agricultural engineering to include studies of this character, in cooperation with the agricultural colleges and experiment stations. I have, therefore, asked Congress for an appropriation which will enable us to employ an expert in farm buildings and farm machinery, in connection with the irrigation and drainage investigations.

DIVISION OF PUBLICATIONS.

The publication work of the Department is a faithful reflex of its activity and growth. The diffusion of the valuable information acquired by the Department is effected almost entirely through this medium. The time was, indeed, when in spite of the comparatively few publications issued, the cost of printing them amounted to far more than half the entire expenses of the Department. At present the entire cost of this work is not even one-sixth of the total expenditures of the Department, and yet the number of publications issued during the past fiscal year aggregated 972. Of these, 379 were new, comprising about 23,000 pages of matter. The number of copies of all publications issued during the year aggregated 12,421,386. The 600 reprints attest forcibly the extent of the demand for the Department publications.

Of the whole number printed 415 were Farmers' Bulletins, of which 25 were new and 390 reprints. The total number of copies of these issued during the year was about 6½ million, very nearly 5 million being distributed upon the orders of Senators, Representatives, and Delegates in Congress.

A very gratifying feature reported by the Department Editor is the constantly increasing demand for the Department publications by educational institutions, mainly for class work. This has added, however, very much to the demands made upon us, and, unfortunately, has greatly increased the instances where it has been found impossible to comply with applicants' requests owing to the exhaustion of the supply.

This suggests the possibility, with the cooperation of Congress, of utilizing, after sufficient time has elapsed, a portion of the unused Congressional quotas of many of our documents. If some plan could

be devised, with the approval of Congress, whereby such unused quotas could be made available to the Department, a great deal of valuable matter would go into circulation which at present is not used in any way.

REPRINTING AND SALE OF DEPARTMENT BOOKS.

It is gratifying to be able to report that Congress at its last session adopted a resolution authorizing the Superintendent of Documents to utilize the funds received by him from the sale of public documents to reprint such as are in continuous demand, subject to the approval of the head of the Department from which the document to be reprinted had emanated. This official courteously supplies the information that out of a total of 47,800 Government documents disposed of by him during the fiscal year, for which he received the sum of $12,606.17, 31,860 were publications of this Department, and the amount received therefor was $4,309.60. This again testifies in a marked manner to the increasing appreciation of the work of the Department, especially in view of the very large gratuitous distribution, not only directly through the Department, but also through members of Congress.

REDUCTION OF COST OF PRINTING.

Every effort has been made to reduce the cost of printing. The editions have been restricted to actual and urgent requirements, and every means to reduce expenses, short of interfering with efficient service, has been resorted to. In the matter of illustrations especially, originally a very natural source of extravagance, rigid restrictions have been imposed. As a result, notwithstanding the considerable increase in the number of publications and in the total number of pages of new matter, the number of illustrations in the new publications issued during the year has been reduced by over 500, or more than 20 per cent of the previous year.

THE LIBRARY.

The Department's collection of agricultural and technical scientific literature has been enriched the past year by the addition, by purchase and gifts, of more than 4,000 volumes. As a working library for the practical agriculturist and scientific investigator this collection of books now stands unsurpassed by any single collection. Some of the special collections of technical scientific works rank among the first in the country. More than ever before have the resources of the Library been made available to scientists in various parts of the country. Loans of this nature, which do not interfere with the progress of work in the Department, are greatly appreciated by experiment station workers in particular. Among the many valuable additions to the Library the past year have been a number of rare entomological

works, which have long been needed to make the collection of books on this special subject more nearly complete. A printed catalogue of the books on entomology in the Library will be issued in a few months, thus adding another contribution to the printed subject-catalogue of the Library.

In return for the large number of Department publications transmitted to foreign countries through the Library, the number of exchanges from governments, institutions, and societies has greatly increased. These publications cover largely the results of current scientific work abroad and are of signal importance in the work of the Department.

The cataloguing of current accessions has practically been kept up to date. Printed index cards for the Department publications have been issued in larger numbers than before to meet the increasing demand from libraries in all parts of the country which receive the publications indexed. In addition to these cards similar cards have been prepared for three important agricultural periodicals, the printing, distribution, and sale of the latter cards having been carried on in cooperation with the Library of Congress. The quarterly Library bulletin of accessions has been regularly issued.

The number of volumes bound the past year has exceeded that of any previous year, yet the desired number of 3,000 volumes a year, until there are no unbound volumes on the shelves, has not been reached from lack of sufficient funds to provide for this work.

With the growth of the Department the work of the Library has increased proportionately, both in the direction of the purchase of books and periodicals and in respect to reference work in connection with current investigations. Each year its steadily increasing resources make the Library a working collection more and more depended upon for necessary data in the furtherance of Department work in its numerous branches.

ACCOUNTS AND DISBURSEMENTS.

The total amount appropriated by Congress for the expenses of the Department for the fiscal year ended June 30, 1904, was $5,258,160, an increase of $244,200 over the appropriations for the preceding year. Of this amount about four and one-half millions had been expended at the close of the year, and the unsettled accounts were nearly sufficient to consume the unexpended balance of $768,839.43. The appropriations for the current year aggregate $5,942,040, an increase of $683,880 over those for the year ended June 30, 1904.

There was received from various sources and deposited in the Treasury the sum of $11,322.58. Among the larger items of these receipts were $4,392.46, resulting from sales of condemned property, $2,960.69

from sales of American products in Europe, and $2,337.33 for telegraph service by the Weather Bureau.

The amount appropriated for rental of buildings for the use of the Department in the District of Columbia for the current fiscal year is $39,820, an increase of $11,920 over the appropriation for the past year.

During the year buildings for the Weather Bureau have been completed at seven different points at a total cost for sites and construction of $70,900. Buildings are in course of construction at four points, the total cost of which will approximate $43,642. The total value of buildings and sites now owned by the Weather Bureau in the District of Columbia and at other points is $382,662.67. The erection of buildings for the use of the Weather Bureau saves a large annual expense for rentals.

PERSONNEL OF THE DEPARTMENT FORCE.

The annual report of the Appointment Clerk shows that the total number of persons constituting the body of the Department of Agriculture on July 1, 1904, was 4,504, an increase of 2,160 since July 1, 1897. In addition, there are nearly a quarter of a million special correspondents and reporters who, although receiving no financial remuneration from the Department, cooperate with it and render it much valuable service. These deserve the utmost credit for the public spirit which animates them.

PROGRESS ON NEW DEPARTMENT BUILDINGS.

The work connected with the new buildings for the Department of Agriculture, authority for which was announced in my last report, has progressed satisfactorily during the year. As already announced, Congress has authorized an expenditure of $1,500,000 for these buildings. For the greater part of the past year the architects have been engaged, under the direction of a committee consisting of three bureau chiefs in the Department, in preparing the detailed plans and specifications for the buildings. The plans were completed in full August 25, 1904, and steps were at once taken for the securing of proposals. In asking for proposals it was planned to have the matter considered under two general propositions: (1) The buildings to be erected entirely of granite, and (2) the buildings to be erected with granite base and marble superstructure. Twenty bids for the entire work were received, opened, and scheduled on November 10. The bids on the complete structure ranged from $1,153,000 to $1,612,000. After careful consideration by the building committee and the architects, it has been decided to erect the buildings with granite base and marble superstructure. The two lowest bids for this work were submitted by Mr. Ambrose B. Stannard, of New York—one for $1,206,000, the other for $1,199,000, the difference of $7,000 in price being caused by the dif-

ference in style of granite used for the base. The committee has unanimously recommended that Mr. Stannard's bid for $1,206,000 be accepted, and this has been done. It is gratifying to announce, therefore, that the actual work on construction will begin within the next few days.

THE LATE COL. J. H. BRIGHAM.

In concluding my report, it becomes my sad duty to record the death of Col. Joseph Henry Brigham, Assistant Secretary of Agriculture, which occurred suddenly at Delta, Ohio, on June 29, 1904.

Colonel Brigham enlisted in 1861 and served throughout the war with great credit, being mustered out with the rank of colonel. From the date of his enlistment, Colonel Brigham may be said to have devoted his life to the service of the public, and especially to the cause of agriculture. He was for six years a member of the Ohio State board of agriculture, and served one year as its president. He had also served in the Ohio State senate, and had been appointed by the late President McKinley, then governor of Ohio, president of the State board of managers of the penitentiary of that State. Prior to his appointment by President McKinley to be Assistant Secretary of Agriculture, however, he was perhaps best known as master of the National Grange, a position which he held for nine years.

While he was serving as Assistant Secretary I had the honor to recommend him for appointment on the Government board of managers of the Pan-American Exposition as the representative of the Department of Agriculture, and he was subsequently appointed chairman of the board by President McKinley. By your appointment he held the same position on the Government board of managers of the Louisiana Purchase and the Lewis and Clark expositions, and he was filling these positions when he died.

Colonel Brigham was frequently designated to represent the Department at important gatherings throughout the country, and on all such occasions he not only succeeded in interesting and impressing his audience, but by his unassuming deportment, genial yet dignified, he added greatly to his own and the Department's popularity. At his funeral at Delta, Ohio, on the 3d day of July last, which served to demonstrate in a marked manner the high esteem in which he was held by his fellow-citizens, his friends and neighbors, the Department was represented by a committee of its officers appointed by me for this purpose.

Born and bred a farmer, Colonel Brigham was a notable example of a man who attained eminence without ever abandoning the occupation of his youth. His experience and judgment, his public spirit and fidelity to duty, made him valuable in every position which he filled, and it is with a deep sense of personal and public loss that I pen this record of his death.

In the foregoing report I have endeavored to show the relation of the farmers to their coworkers throughout the country, and also the leading position which agriculture occupies among our industries. I have endeavored to give an outline of some of the directions in which the Department seeks to help the farmers of the United States. Its existence is justified only by the extent to which it serves the tiller of the soil through research and the practical application of science.

Respectfully submitted.

James Wilson,
Secretary.

Washington, D. C., *November 26, 1904.*

THE RELATION OF PLANT PHYSIOLOGY TO THE DEVELOPMENT OF AGRICULTURE.

By Albert F. Woods,
Pathologist and Physiologist, Bureau of Plant Industry.

INTRODUCTION.

In a brief consideration of the relation borne by plant physiology to agricultural development it will be possible merely to call attention to some of the more important improvements in the art of agriculture that have resulted from the development of plant physiology, and to indicate some of the more important directions in which this science may affect the agriculture of the twentieth century. It will be necessary to call attention briefly to the origin of our cultivated plants, the discovery of the sexuality of plants, the discovery of the nature and sources of plant food, and the nature and causes of plant diseases. It will be desirable also to consider briefly the training in plant physiology required for the investigator, the teacher, and the farmer.

ORIGIN OF CULTIVATED PLANTS.

In its strictest sense, the word "agriculture" refers to the cultivation of the soil for the purpose of increasing the growth and yield of valuable plants. In its broadest sense, agriculture is the oldest and most fundamental of all the arts of civilization. The first steps in agriculture must certainly have been the simple stirring of the soil in search of edible roots, followed by the observation that plants grew better and yielded more abundantly in such stirred soil. The stimulating effect of excrement and decayed organic matter must also have been very early observed and practiced. In the early stages of agriculture the cultivation of special food plants in patches or fields on soils most conveniently located and easily cultivated and giving the best results was a simple and natural step even for the most primitive man. In accordance with the practice of all plant-eating animals, man selected for his use the individual plants which he liked the best and which produced valuable returns for him with the least labor on his part. Thus, there gradually came into existence selected and cultivated strains of plants better adapted than their wild progenitors to the uses of man. The changes or variations were slight at first, but

we know from experience how greatly wild plants may be modified and improved by cultivation and selection.[a] Within a few years such treatment is often sufficient to make them almost unrecognizable. It is thus easy to realize how great the changes must be that are produced by centuries and centuries of such treatment under a great variety of conditions.

The process has thus been essentially a natural selection, man's like or dislike being the critical factor. Darwin was the first naturalist to fully comprehend this fact, and it was the study of variation under domestication and the history of domesticated plants and animals that enabled him to comprehend the great influence of continued selection in the modification and origin of species. Up to the time of Darwin, about the middle of the nineteenth century, the dogma of the constancy of species was almost universally believed. Species were held to be special creations, a theory which effectually answered all questions as to origin and stifled investigation. But regardless of any theoretical notions held by philosophers of that time, agriculturists realized the great importance of selection and crossing in the improvement and modification of animal species. Darwin quotes from Youatt, who, he says, was probably better acquainted with the works of agriculturists than almost any other individual. Youatt speaks of selection as "that which enables the agriculturist not only to modify the character of his flock, but to change it altogether. It is the magician's wand, by means of which he may summon into life whatever form and mold he pleases." He, of course, refers to the art of animal breeding, which is of very ancient origin and practice and differed from the practice of the early plant breeders in that hybridization and crossing, as well as careful selection, were followed by the animal breeders.

The sexuality of plants, however, was not known until comparatively recent times, and crossing and hybridization were not, therefore, consciously used in the early development of our agricultural plants. The first scientific proof of the sexuality of plants was furnished by Camerarius in 1691. It was not until twenty years later, however, that the first recognized plant hybrid was made.

PLANT BREEDING.

The knowledge gained in the early part of the eighteenth century was enlarged and somewhat improved in its scientific aspects, but was not put to much practical use until near the end of the eighteenth and the early part of the nineteenth century, when Thomas Andrew Knight, an energetic plant physiologist and horticulturist, gave the

[a] See Yearbook of the Department of Agriculture for 1896, pp. 89–106.

first great impulse to breeding as a method of improving plants. He recognized hybridization and crossing as the most potent means of inducing variations in definite directions, thus purposely producing changes which before were the result of chance development or which did not occur at all, and he was thus able to bring about desired modifications in a very short period of time. He recognized the slower method of inducing variation by cultivation and increased food supply, but realized that the changes that can be produced by selecting such induced variations are narrow and slow compared with what can be secured through hybridization and crossing, followed, of course, by careful selection to fix the desired types.

While there has been much advance in the scientific and practical knowledge of plant improvement in the last fifty years, we are still in the beginning of the work. In the earlier years of the nineteenth century most of the work that was done was in the nature of a refinement of the older methods of selection. The important bearing of the work of Knight was not fully appreciated, but recently there has been a rapidly growing recognition of the importance of hybridization and crossing. If it were possible to get at the facts, we should doubtless find that much of the progress in the past has been due to chance hybridization and crossing. The best that is in a variety can be brought out by selection, but when the plant does not possess desired characters they must be introduced by combining the good points of several varieties or species, either cultivated or wild.

A good start has been made in thus combining the European and native American grapes. The production of grapes for general purposes, which has been the aim of practically all the work on grape breeding thus far, has been accomplished and even carried too far, as is so clearly pointed out in Bailey's excellent work on the evolution of our native fruits. The great need now, as there suggested, is for varieties suited to special purposes, special soils and climatic conditions, and resistant to diseases and insect pests. These may be produced by combining the desirable qualities of our wild and cultivated varieties with the good qualities of the European types.

The combination of our native American plums with the older cultivated sorts has been in progress for little more than twenty years, but many new and valuable varieties have already been produced. Hardy varieties of apples are being produced by combining the qualities of our wild crab and of the hardy Russian sorts with the good fruit qualities of the cultivated varieties grown farther South.

Similar work is being done with the orange by combining the fine fruit qualities of the Florida sweet orange with the cold-resistant qualities of the hardy trifoliate or hedge orange, which is commonly grown in the North as a hedge plant. Hardy oranges of good quality

have already thus been produced, as described in another paper in this Yearbook,[a] and their further improvement is assured.

Very valuable varieties of the pomelo have been produced by crossing this fruit with the tangerine. These are nearly seedless and have a loose rind like the tangerine, but retain the pulp characters of the pomelo. This new fruit is called the tangelo. The small, rather dry tangerine, by crossing it with the orange, has been made larger and more juicy without losing its other qualities.

Scarcely an important fruit, flower, or vegetable can be mentioned that has not in the past fifty years been greatly improved for certain purposes through the production of special varieties by hybridization.[b] More has been accomplished with fruits and with flower and vegetable crops than with any other classes of plants, but important advances have also been made with the cereals and forage crops by increasing yield and hardiness; and the work of the Department of Agriculture indicates that we shall be able to obtain by hybridization and selection drought resistance, alkali resistance, and resistance to rust and other diseases.

In nearly all our important crops greater improvements have been made within the last fifty years as the result of our knowledge of the causes of variation and the principles of selection and hybridization than have taken place before in historic times. This progress is the direct outgrowth of the discovery of the sexuality of plants and the laws of variation and heredity as applied to them. The physiologist is seeking to work out still more accurately the laws of variation, correlation, and heredity. When these are better understood, breeding will become a still greater power for the betterment of agriculture.

THE FOOD OF PLANTS.

Next to the development of physiological knowledge which furnishes the basis of plant breeding, the growth of knowledge relating to plant nutrition has had the most important bearing on the art of agriculture. The germ of our modern theory first became evident about the beginning of the eighteenth century. Previous to that time it was believed that plants obtained all their food from the soil, although the elements and compounds constituting even soil foods were not known.

The first step in advance was the demonstration of the fact that the leaves take part in the elaboration of food and that the larger part of the substance of plants is derived from the atmosphere. The lack

[a] New Citrus Creations of the Department of Agriculture, p. 221, of this volume.

[b] See Progress in Plant Breeding, Yearbook of the Department of Agriculture for 1899, p. 465, and Yearbook of the Department of Agriculture for 1901, p. 217; also, Hybrids and their Utilization in Plant Breeding, Yearbook of the Department of Agriculture for 1897, p. 383.

of chemical and physiological knowledge at that period, however, made it impossible to proceed far in explaining these observations. It was not until nearly the end of the eighteenth century that definite proof was furnished that plants absorb and fix the carbon dioxid of the air and give off oxygen in the process, at the same time assimilating the elements of water and increasing in weight in a corresponding degree. This process was found to take place only in the light and only in the green parts of plants, and normally and copiously only when small quantities of certain mineral matters were absorbed by the plant through the roots. It was also observed, about this time, that all parts of a living plant absorb oxygen and give off carbon dioxid, just as animals do in respiration. The conclusion was reached, though founded on imperfect experiments, that plants can not make direct use of the nitrogen of the atmosphere. The great importance to agriculture of these observations was soon lost sight of, however, in a mass of unimportant matters and misinterpretations, and it was not until the appearance of Liebig's work in 1840, and especially until the investigations of Boussingault, between 1840 and 1850, were made, that the error was cleared away and the important facts clearly set forth.

It has thus been scarcely more than fifty years that we have had information on the subject of plant nutrition that could profitably be applied to agriculture. During this period very rapid progress has been made in working out the more complex chemical and physiological problems involved in the absorption, modification, and assimilation of the several food elements under various conditions and from various compounds or sources.

The essentials for the growth of most of our cultivated plants are that they shall have favorable light, air, temperature, and moisture conditions for the growth of the leaves, stems, and fruits, and a favorable quantity of air and moisture in the soil, with such soluble compounds of nitrogen, phosphorus, potassium, calcium, magnesium, and iron as are best adapted to the particular crop.[a] The demonstration of these requirements has placed in the hands of the farmer the means of maintaining and increasing the fertility of the soil, and has enabled him in many cases to make soils productive that before were barren. The knowledge that plants need light and air and that the larger portion of their food comes from the air has brought about a modification of cultural conditions by giving plants more room in which to grow, with a consequently greatly increased yield. Based on a scientific knowledge of nutrition, the art of feeding plants has developed within the last fifty years in a most remarkable degree. The well-informed

[a] See Relation of Nutrition to the Health of Plants, Yearbook of the Department of Agriculture for 1901, and Fertilizers for Special Crops, Yearbook of the Department of Agriculture for 1902. Reference to other literature on this subject is given in the articles cited.

farmer now knows that the varying combinations of essential conditions and elements that occur naturally in different soils and climates are an index to the adaptability of these climates and soils for special crops. He knows also that these conditions can be modified favorably or unfavorably by cultivation and fertilization. He understands the importance of a physical and chemical examination of soils as indicating the presence or absence and the relative proportions of the essential elements of plant food.

The final test, however, is the physiological one of determining by actual trial whether certain crops are adapted to particular conditions and how the conditions may be made more favorable. The physiological examination should also determine what beneficial or injurious micro-organisms are present in the soil and the changes which these produce. There are some bacteria and fungi that cause the decay of the organic remains of animals and plants, leaving the nitrogen and other elements of plant food in the form of compounds available to crops. On the other hand, there may be present organisms which produce substances in the soil directly or indirectly unfavorable to crops. The life history and habits of all these forms must be carefully determined and the useful kinds put to work and the injurious ones eliminated.

Very little has yet been accomplished in this particular field except in connection with the problem of nitrogen fixation. Many investigators have worked upon the latter problem, and step by step the important facts have been discovered. The Department of Agriculture has had a hand in the later developments of this work. The physiologists of the Department have succeeded in working out the complete life history and habits of the root tubercle bacteria which, living in the roots of legumes, secure nitrogen from the atmosphere, thus enabling these crops to grow luxuriantly in soils devoid of this scarcest and most expensive of all food elements. Soils poor in nitrogen may, by the use of these bacteria and proper legumes, be enriched from the inexhaustible supply of nitrogen in the atmosphere. The nitrogen-fixing power of these bacteria has been increased more than fivefold by cultivation and selection on nitrogen-free media in the laboratory.

A cheap and thoroughly effective way of distributing and applying these organisms in general agricultural practice has been devised and put into use on a large scale. At a cost of a few cents a bushel, the seeds of clover, alfalfa, peas, beans, or any other legumes may be inoculated with these bacteria, thus making it possible to secure good crops on soils devoid of nitrogen, and at the same time leave a large quantity of this element fixed in the soil in a form available to wheat, corn, potatoes, or any other crop that may follow the legumes. The bacteria are helped to live and multiply by their host plant, the host in turn is supplied with nitrogenous food by these bacteria, and the host

upon dying leaves its decaying roots, leaves, etc., to supply stored-up nitrogen to succeeding crops, or to neighboring plants which may outlive the legume and feed upon its disorganized parts. The value of legumes as restorers of fertility, apart from their value as food, has thus been greatly increased. These crops without the nodule-forming bacteria exhaust the nitrogen of the soil, like any other crop.[a]

This investigation, however, does not stop with the nodule-forming organisms. There are other bacteria known which have the power of fixing nitrogen from the atmosphere independently of any particular crop. It may be possible when the life history and habits of these species are fully ascertained to improve, cultivate, and distribute them as we do the tubercle forms. If this can be accomplished they will supplement the work of the tubercle bacteria and will add greatly to the world's supply of stored nitrogen, which is one of its greatest sources of wealth.

NATURE AND CAUSES OF PLANT DISEASES.

A third phase of plant physiological investigation which has resulted in immense benefit to agriculture has been the study of the causes, prevention, and cure of plant diseases. In the past, as now, very great loss in crop production has resulted from attacks by insect and fungus pests. It has been scarcely a century since the scientific investigation of plant diseases began and hardly more than half a century since enough has been known of plant physiology and of the life history, structure, and physiology of bacteria and fungi and their causal relation to diseases to be of any practical value to agriculture.

The rusts of cereals in damp seasons often destroy these crops or greatly reduce the yield and quality of the grain over immense areas, thus causing serious loss and suffering, and often famine. Many species of rusts have been discovered, some more destructive than others. The parasites causing the disease have been in some cases carefully studied, but much of their life history and habits remains yet to be learned. One of the most important facts discovered is that some of the most destructive forms, like the black rust of wheat (*Puccinia graminis*), have several distinct stages, formerly believed to be entirely separate fungi and to have no connection with each other. When De Bary found, however, that the cluster-cup rust of the barberry was a stage of the wheat rust and that the wheat was infected from the spores of the barberry rust a common observation of farmers was explained, namely, that wheat rust is most severe near barberry hedges. Laws were passed requiring the destruction of barberry hedges, and this particuliar form of wheat rust was then

[a] See Bacteria and the Nitrogen Problem, Yearbook of the Department of Agriculture for 1902; also, Bureau of Plant Industry Bulletin No. 71, and Farmers' Bulletin No. 214.

greatly reduced. The investigation also demonstrated that the black-rust stage on wheat could not infect the plant directly, but could infect the barberry, producing the cluster-cup rust of that plant. The spores of the barberry rust were found not to infect the barberry but the wheat plant, producing first the form known as the red rust on the leaves and developing later on the same plant into the black rust.

The red-rust stage of the wheat rust can not infect the barberry, but spreads the disease rapidly over wheat fields, producing a new generation about every two weeks. The great epidemics of wheat rust are due to this red-rust form of the fungus. If the season is moist and the spores from each generation are able at once to germinate, the multiplication is so rapid and continuous that before the grain is ripe the host plants are so overwhelmed by the quantity of the rust that their vitality is sapped and their supply of plant food to the developing seeds is so reduced in quantity that only a few and imperfectly developed seeds are produced. In some localities where this form can not live over winter it is simply necessary to get rid of the barberries, as above suggested, and the disease is eliminated; but in many places, especially in the great wheat regions of our own country, the red-rust stage of the fungus lives over winter on winter wheats, volunteer wheat, and perennial grasses, and possibly on other plants, and directly infects the wheat crop of the next season, as demonstrated by the investigations of this Department. Infected regions thus have more or less rust every year, but the prevalence of the disease depends more upon the conditions favoring or preventing the germination of the spores than upon the number of spores living over winter and present in the spring.

Fungicidal treatment for rusts has so far proved valueless, but much more investigation is needed along this line. The most helpful developments will doubtless be in the production of rust-resistant varieties through selection and hybridizing followed by further selection, thus, for example, breeding into the tenderer wheats the rust-resistant qualities of the durum and emmer varieties.

The smuts of wheat, oats, rye, barley, etc., form another class of diseases which have in past ages caused and still continue to cause immense loss. Pathologists have been more successful in overcoming this class of diseases. Where formerly from 20 to 40 per cent of the cereal crops were annually destroyed, now, by a simple and cheap treatment of the seed before planting, using formaldehyde, hot water, or copper sulphate, the loss may be reduced to less than 1 per cent.

The discovery by Millardet about twenty years ago of the remarkable fungicidal value of Bordeaux mixture was the starting point of the scientific and practical development of the use of fungicides, and has resulted in a very wide use of the compounds of copper

for the purpose of preventing plant diseases. Several destructive diseases of potatoes, such as early blight and late blight, or potato rot, which often cause great loss to the growers of this crop, are now easily prevented by spraying the plants with Bordeaux mixture; and by adding a little Paris green to the mixture protection is afforded by the same treatment against the ravages of the potato beetle. The black rot and brown rot of the grape, which at one time practically destroyed the grape industry of the Central and Eastern States, have been carefully investigated and an effective remedy found in Bordeaux mixture. In fact, this mixture, which is a combination of copper sulphate and lime, has been found an effective protection against the larger number of parasites which attack plants through the leaves, stems, or fruit.

In the case of root diseases caused by parasites in the soil or other unfavorable soil conditions, the development of resistant strains or varieties is often the only method practicable. Much has been accomplished in this direction. For example, varieties of grapes have been bred resistant to the California vine disease, which has annually destroyed the industry in several sections of southern California. The phylloxera-resistant quality of our native grapes has been made use of in breeding resistance into the tenderer European varieties, and our native varieties have also been used directly as stocks on which to graft the tender European sorts. This procedure has saved the grape industry of Europe, and is being used to a large extent now in California to guard against phylloxera.

Strains of cotton resistant to wilt, a very destructive disease caused by a fungus living in the soil, have been developed by selection. Cowpeas resistant to root-knot and wilt have been produced, and a valuable new variety of watermelon, which will grow successfully in wilt-infected soils where other melons fail, has been developed. This was accomplished by combining the wilt-resistant qualities of the citron with the fruit quality of the melon by hybridization and selection. Flax varieties resistant to flax wilt have been produced. Considerable progress has also been made in securing by breeding and selection strains of important crops resistant to alkali.

While much has been accomplished in this phase of physiological investigation to enable the farmer and the fruit grower to guard against loss, to save great industries from destruction, and to establish new industries, there is still a much greater work to be accomplished. The life history of organisms causing disease has been thoroughly worked out only in a very few cases. The causes of susceptibility or resistance to disease in the host plant and the whole question of immunity have hardly been touched upon for most diseases. Diseases caused by unfavorable atmospheric and soil conditions and the relation of nutrition

to the health of plants constitute a very imperfectly explored field.[a] Fungicidal and bactericidal treatment of diseases may yet be greatly improved. One possible direction of improvement in this connection is the finding of substances toxic to the pathogenic organism, but harmless to the host plant even when absorbed by the plant in quantity large enough to inhibit the growth or prevent the action of the invading organism. This has been accomplished in animal pathology in a number of instances. Recently the Department physiologists have found that water solutions of metallic copper or of copper sulphate, so dilute as to be absolutely harmless to man and the higher animals, are very destructive to the bacteria causing typhoid fever and Asiatic cholera, and to noxious algæ contaminating water supplies.[b] Copper sulphate has been used very successfully in destroying these contaminations of water and in connection with the arsenite of copper in treating typhoid fever. There is good reason to believe also that metallic copper in so-called colloidal solution will be found effective in treating certain other diseases caused by bacterial infection, and possibly also for cancer, as the writer suggested several years ago.

Briefly recapitulating, we see that our power to modify plants according to our needs has been very greatly increased and perfected by the development of plant physiology; that the working out of the nutritive requirements of plants has enabled us to maintain and increase the fertility of soils, to increase the yield and quality of crops, to prevent waste of valuable food elements, and to set to work and to improve nature's machinery for the accumulation of nitrogen from the atmosphere in combinations available to crops. It has also enabled us to discover the causes and find remedies for many of the most destructive diseases of crops. The result of all this in the last ten or fifteen years has been to enable the progressive farmer to protect and control his crops to a degree never before believed possible, and scientific farming is now fast becoming one of the safest forms of investment of capital and labor.

PLANT PHYSIOLOGY FROM THE EDUCATIONAL STANDPOINT.

It is evident from what has already been said that the science of plant physiology began with the farmer. The farmer made the first observations on the effects of cultivation and manuring. His success in the improvement of plants by selection and in the development of fine breeds of stock by crossing and selection was the key to the solution of the problem of the origin of species. The power to observe carefully and to draw correct conclusions has not been limited to

[a] See article on this subject in the Yearbook of the Department of Agriculture for 1901, p. 155.

[b] See The Contamination of Public Water Supplies by Algæ, Yearbook of the Department of Agriculture for 1902, and Bureau of Plant Industry Bulletin No. 64.

scholars and scientists. In nearly every industrial field the first great steps were taken by practical men, often with no special training other than that obtained by hard work, experience, and earnest thought in their chosen vocation. The explanation of this is that the practical workers were doing in the field and workshops the real experimenting and observing with a definite aim in view, and this is the foundation of the so-called modern laboratory method.

The remarkable developments in every branch of science and industry that have taken place in the past century have also been due in large part to the introduction of more accurate methods of study, observation, and interpretation, and the attempt by such methods, instead of those of scholastic philosophy, to get at the truth of things. For the development of these methods as applied to scientific investigation we are indebted very largely to chemistry and physics. It is not practicable nor profitable for the farmer or the mechanic to go deeply into experimental work. Their business is to produce, by the best-known methods or processes, with a net profit to themselves. In the field where plant physiological knowledge or investigation can aid the farmer it is the business of the physiologist first to consider the problems from the industrial standpoint and then to solve them according to the most accurate and expeditious methods. It is the aim of plant physiology to determine the nature and causes of all vital phenomena in plants, to determine their relation and importance to the life of the organism, and to discover the methods of controlling these activities. Our ability to control them is the proof that we understand their cause and nature. It is the application of this method of proof that has made applied science so much more productive of great discoveries and generalizations than so-called pure science. But in spite of the great advance that has been made in the art of agriculture during the last century as the result of the discoveries in plant physiology, chemistry, and physics, we have only begun to realize what the future has in store for us. The relation of plant physiology to the principles and future development of agriculture must finally be considered from the educational standpoint. What must be the training of the investigator in applied plant physiology, and what must be the training of the teacher, the farmer, and the horticulturist?

THE INVESTIGATOR AND THE TEACHER.

The training of the investigator in plant physiology, as in all other sciences, should logically begin in the primary schools. He should be taught how to observe and study the particular objects and phenomena of nature with which he comes in contact. It is the old method again of studying things themselves instead of studying books—applied, as it should be, in the very beginning as well as in the later stages of

education. This fundamental training in the general principles of natural history can be accomplished, along with drawing, manual training, reading, writing, mathematics, history, geography, etc., by a process of natural development and growth instead of the cramming and forcing process so common even now in our schools. It is true that the lack of competent teachers makes it difficult to apply this method, but when we realize the need we will strive to meet it. In the end, the plant physiologist, besides a good general training in other subjects, must have an accurate and thorough knowledge of the general principles and methods of investigation in physics, chemistry, geology, meteorology, and general biology. The vital activities of plants are in accord with chemical and physical as well as biological laws, and can not be understood apart from environment.

Too much stress can not be laid upon the thoroughness and accuracy of this general training. In the haste to specialize, now so rampant, general training is too often neglected, this part of the education being discontinued too early; both general and technical education should proceed together. General biology must, of course, include both the animal and vegetable groups of living organisms. There must be a general survey of evolutionary development, a study of types from the simplest to the most complex, a study of comparative general morphology, anatomy, and physiology in the broadest sense, and finally a special knowledge from these standpoints of the vegetable kingdom in particular. This survey must lay special stress upon domesticated plants and animals as compared with wild species. It is such comparative study, as Darwin first forcibly demonstrated, that reveals Nature's secrets.

To gain this knowledge of cultivated plants it will be necessary for the plant physiologist to take a practical course also in agronomy and horticulture. The field, the orchard, and the garden are the best laboratories for this purpose. Throughout this training exact and accurate methods of physiological investigation must be acquired and the mind must be trained to sift evidence and draw accurate conclusions, to develop hypotheses and test them. Initiative must be encouraged and developed, and the economic relations of all questions must be appreciated.

Besides the training already described, the investigator in physiology must have a good reading knowledge of the more important modern languages, especially German and French. He must keep in touch with what other workers are doing in his own and related lines.

This very brief and imperfect sketch is presented not as an ideal, but as an absolute necessity for anyone who wishes to go into the real business of physiological investigation as it relates to agriculture. Experience has proved that men with such training can solve the difficult problems and can see and understand phenomena of the greatest

importance that others have overlooked or have misinterpreted, and can greatly aid in plant production.

The teacher must have this same training and knowledge, and besides have the ability to encourage and help others to obtain it.

THE FARMER AND THE HORTICULTURIST.

The fine art of modern agriculture is as much beyond the uneducated and untrained man as the art of sculpture is beyond the ordinary quarryman. The poor of the cities can not be sent to the country and there made into farmers as easily as some superficial observers may think. The young man who would be a farmer or horticulturist must either be trained by some experienced member of the profession who has kept abreast of the times and has made a success of farming or horticulture, or he must go to an agricultural school, where agricultural training is made a business. A combination of both is still better. If a correct educational system has been followed in the common schools under competent teachers, the young agriculturist will have when he comes to the agricultural college a practical knowledge of farm operations and a good general elementary education, including a training in the elements of natural history, before described as desirable for the young physiologist.

It may be possible to obtain this training from the primary graded schools of our towns and cities. It is, however, much more likely to be secured through the newer system of consolidated rural schools now being adopted in our most progressive agricultural States. This rural-school system starts with a primary school and leads up to the agricultural high school and college of agriculture, and has as its aim, from bottom to top, the training of agriculturists. The system meets a recognized economic and educational need and is sure to take a place coordinate with the older systems.[a]

As a result of his study in the college, the young agriculturist must understand and be able to make use of the general principles of physics, chemistry, and geology, with special reference to soils, meteorology, and general biology. He must learn the reasons for the technical agricultural processes and be able intelligently to modify and vary these processes to meet varying conditions; he must be able to understand and make use of improved methods in agricultural technology; in short, he has to learn how to produce by the best and most economical methods.

The botanical training should consist of a general survey of the vegetable kingdom, with special reference to the origin, relationship, and physiology of cultivated plants and those of economic importance.

[a] See article by Hays, Our Farmer Youth and the Public Schools, in American Monthly Review of Reviews, October, 1903.

The economic relations of bacteria and fungi must be studied with special reference to controlling and protecting the valuable species and guarding against the injurious species. The farmer should be able to recognize the more important and destructive plant diseases and know how to guard against them. He must understand the principles of reproduction and propagation and methods of plant improvement by seed selection, cultivation, and hybridization. He must know how to maintain and increase the fertility of soils and must recognize the adaptability of soils to special crops. This involves a knowledge of food requirements of special crops and the most economical means of furnishing the required food. In a host of other ways also, a knowledge of the physiology of plants will enter into the technical processes of farming or fruit growing. The paramount idea should be not to make botanists, chemists, or zoologists, but to furnish the foundation training for the development of experts in farming, or fruit growing, or animal husbandry. There must be the closest sympathy and touch between the investigator, the teacher, and the practical worker. They are a trinity with a unity of purpose—the development of a perfect art of agriculture.

ATTITUDE OF LUMBERMEN TOWARD FOREST FIRES.

By E. A. Sterling,
Forest Assistant, Bureau of Forestry.

FIRE THE GREATEST ENEMY OF FORESTS.

Of the many destructive agencies at work in the forests of the United States, fire holds first place, and the loss which it inflicts equals, if it does not surpass, that from all other causes combined. Insect hordes occasionally destroy large areas of valuable forest growth; wasteful and short-sighted lumbering methods, resulting from involved economic conditions, have brought about the rapid conversion of much of the finest timberland into unproductive barrens; and in the far West excessive and unrestricted grazing has seriously reduced the regenerative power of the forest and exposed vast areas to injury by flood and erosion. But great as is the damage from these causes, compared with fire they are of secondary importance. Further, it is to the fires which usually precede, accompany, or follow these other agencies that their most serious consequences are often due. Insect attacks often follow when fire has killed or reduced the vitality of timber; the cut-over timberlands of the Great Lakes and other regions would not present such a discouraging aspect had not fire killed the seed trees and young growth, which otherwise would have survived even the most pernicious logging; and in the forests of the West fire again is a potent source of difficulty in adjusting the conflicting claims of the grazing, timber, and water interests.

SOME ESTIMATES OF LOSSES FROM FIRE.

Certain as it is that fire is the greatest of forest evils, there exists comparatively little accurate knowledge on which to base an estimate of the total loss from this source. This is due not to lack of interest so much as to the immensity of the field and the complex character of the problem which the attempt to make such an estimate presents. Losses of mill and logging machinery, lumber, cordwood, merchantable standing timber, and other property of stable market value can be closely determined by individual losers, but when attempts are made to combine even these definite losses for a State, or for the United States, the result becomes a rough estimate, if not a matter of mere conjecture. Nevertheless, it is indisputable that these losses are

enormous, and that, for the country as a whole, they run high into the millions. The most conservative estimates put the average annual loss from forest fires at above $25,000,000. More exact estimates are available for limited regions. For example, a careful estimate made on the ground after the terrific Washington and Oregon fires of 1902 showed a loss in nine days of $12,000,000 worth of forest property. New York State in the spring of 1903 suffered from unusually severe fires in the Adirondacks, involving a direct loss estimated at $3,500,000, in addition to a known expense for fire fighting of $175,000.

LOSSES FROM FIRE WHICH ARE NOT USUALLY CONSIDERED.

But the severest consequences do not result from these great conflagrations, which partake of the nature of national calamities. Beyond question it is the smaller, unnoted fires which, in the aggregate, inflict the most serious damage upon the forests of the United States. And this damage is for the most part of a kind, from the very nature of the case, incapable of exact calculation. In the first place, much fine timber in this country has at present no money value, because it is not now accessible. In the second place, the injury which the forest suffers is far greater than that covered by the stumpage value of the standing merchantable timber. Generally the lumberman is immediately concerned only with that part of the fire loss which includes the destruction of timber and lumber that he can sell, and of milling or logging property in the woods. The annihilation of young growth and the lowering of the forest's water conserving and regenerative powers do not appear in the profit and loss column of his books. From the point of view of the public interest the effect of fires on forest reproduction and water conservation is far more important than the destruction of mature timber, yet the impossibility of even approximately determining the former losses makes them appear less real. Save in limited regions, young forest growth has no recognized value; consequently its destruction by fire is not an appreciated financial loss. In view of the growing scarcity of timber and of the almost inevitable changes in the general field of forestry, it is safe to prophesy that in the near future the value of young growth will be definitely recognized. Nevertheless, lumbermen have not as yet generally recognized it, nor taken steps to encourage or protect such growth. (Pl. I.)

CONDITIONS WHICH AFFECT FIRE LOSSES.

The extent to which lumbering interests suffer from fire depends largely on the region in which they conduct their operations. Broad statements concerning this are subject to exceptions, yet in general it is true that Pacific Coast lumbermen suffer most, and those in the southern hardwoods least; while the losses of operators in the Lake States

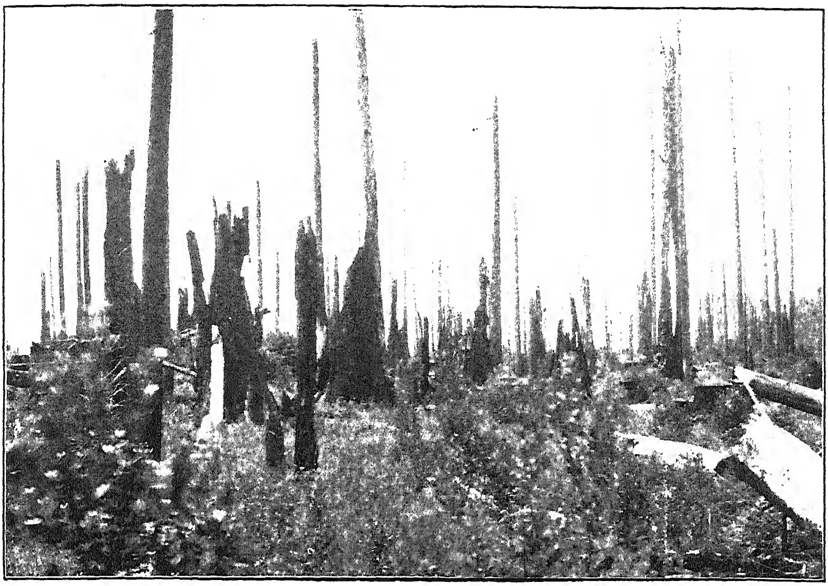


FIG. 1.—GENERAL VIEW A FEW YEARS AFTER THE REDWOOD LUMBERMAN HAS FINISHED HIS WORK. HUMBOLDT COUNTY, CAL.

[It is noticeable that few of the stumps are sprouting.]

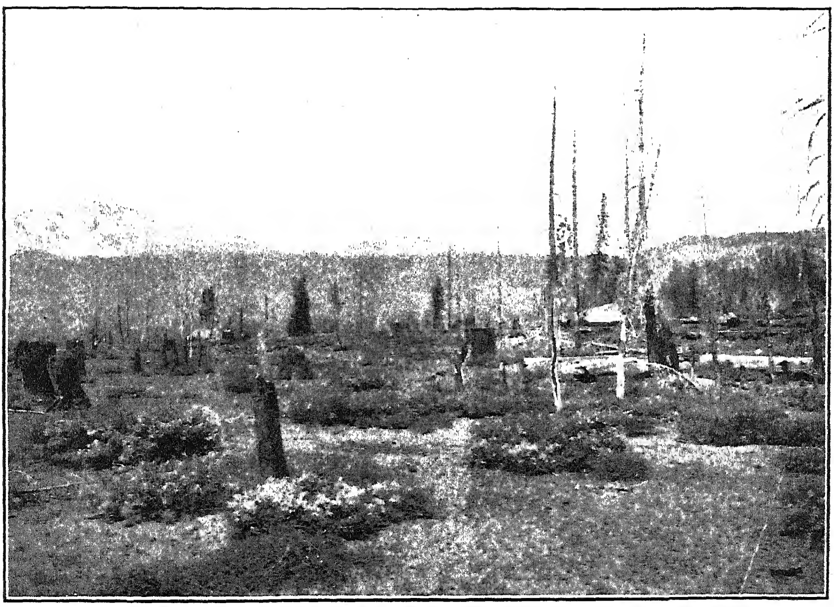


FIG. 2.—CUT-OVER LAND BURNED SIX YEARS AGO (1898), SHOWING DEAD TREES AND HOW CEANOTHUS CORDULATUS IS TAKING POSSESSION. ELDORADO COUNTY, CAL.

and the Northeast fall between the two. The Pacific Coast lumber manufacturer is the heaviest loser, not only because the fires are more severe, but also because his mills and yards are located in the heart of the forest, since he can not "drive" the streams. In California and eastward surface fires prevail in the virgin forests, but rarely destroy extensive stands of timber, although individual trees are severely injured and often killed. In the Northeast and Great Lakes States fires commonly do not reach their maximum of injury until the lumberman has left; hence he is not so great a sufferer. In the Southern pineries the frequently-occurring grass fires are rarely severe, and are seldom troublesome to lumbermen. Old turpentine orchards, where the boxes and excoriated surfaces expose the trees to fire injury, are the exception. Such timber, however, is usually purchased at a low figure and cut before fire does it material damage.

ERRONEOUS IDEAS CONCERNING EFFECTS OF FIRES.

The effect of surface and brush fires in large timber is more serious than is generally supposed. The prevailing opinion is that mature timber is not injured by such fires, and this has created among lumbermen a feeling of indifference to their occurrence. Few fires in a forest are so slight as to produce no ill effects. Though most of the trees may escape with only a slight blackening or charring of the bark, there are invariably others which are killed or injured at the base by the burning of brush and débris accumulated about the trunk, or by the fire catching in a break in the bark. Each successive fire adds its percentage of injury, while all damaged trees are rendered less windfirm. Even in the southern pines, where the fire injury is near the minimum, the cumulative damage is surprisingly great. The Bureau of Forestry has obtained figures which show that in a turpentine orchard of Florida longleaf pine, abandoned for five years, 33 per cent of the trees above a diameter of 1 inch were found dead or down, mainly as a result of fire, while only one-half of 1 per cent of the remaining boxed trees were unburned. The damage in unboxed longleaf pine of the same region was much less serious, 82 per cent of the stand being sound. Throughout California the opinion so largely prevails that fires in virgin timber are comparatively harmless that lumbermen allow them to run unless they threaten their mills or are likely to spread to "slashings" in dangerous proximity to valuable timber. This, too, is in the face of the fact that nothing is more noticeable in the Sierra forests than the burned-out bases of many of the finest sugar and yellow pines. (Pl. II.) Figures obtained in the logging camps of a lumber company in Tehama County show that the "long butting" necessitated by the burns in the base logs amounts to about 4½ per cent of the total cut, which is a direct loss of this amount. This does not include

the loss in high stumps, where the cut is made above the burn, nor allow for the deduction from the actual scale reading in partially burned-out logs, nor for the inferior lumber near the burns, where the heat has hardened the pitch. In addition to this, many trees have burned down or have been thrown by wind as a consequence of the fire.

VIEWS OF LUMBERMEN CONCERNING FOREST FIRES.

The general attitude of lumbermen toward forest fires is one of hopelessness, coupled in a measure with indifference. Fires were not unknown prior to the days of settlement, but since the commercial exploitation of the forests began they have increased in number and severity, until now they are regarded as inevitable. Considering the many causes from which forest fires spring, the difficulty of quickly locating and suppressing them in the incipient stages, and the tremendous and often impossible task of stopping a fire when it has attained full headway, it is not to be wondered at that the lumberman has taken rather a hopeless view of the matter. Furthermore, fire fighting and even crude measures of protection require an outlay which could not have been borne during the earlier lumbering period. There has been, too, an unfulfilled State duty which has added to the lumberman's burden. Large sums raised by taxes on forest land have been going into the State treasuries, yet until very recent years no intelligent effort has been made to assist timber owners to protect their holdings. While lumbermen should have done more for themselves, the laws which should have given them encouragement and assistance have been wanting or totally inadequate.

The attitude of indifference which has been shown by lumbermen in many instances is far less excusable than their belief in the impossibility of fire protection. Realizing the fire danger, they have deliberately ignored all sides of the question save that of the most temporary protection, and have taken the best from the land and abandoned the rest to destruction by fires which often threatened or destroyed the adjoining property of others. The only justification for this has been the economic conditions which have made the suppression of fire incompatible with profitable lumbering.

CHANGED CONDITIONS.

Before the awakening to the needs and possibilities of forestry and when the forests were considered inexhaustible, indifference and inaction when forest fires occurred was not unnatural. These conditions, however, are now of the past. The end of the virgin timber supply is in sight, and the improved tone of the lumber market is enabling lumbermen to dispose of inferior material and to realize better prices for all

grades. These changes are making it profitable for timber owners to cut more conservatively and to hold their land for future timber production.

In pursuing such a policy, fire protection and the systematic disposal of "slash" by methods which will result in the minimum of injury to young growth and seed trees must follow. It is most encouraging that many large lumber concerns, especially in the West, are favoring the adoption of such a policy, and in a few cases are putting it into practice. In short, lumbermen are beginning seriously to consider the advantages of long-continued management of timber-lands, in place of the policy of temporary speculative holdings upon which their operations have hitherto been based. With this change in general management must come an entirely altered sentiment toward forest fires. They can no longer be ignored, but must be intelligently and systematically guarded against.

FIRE PROTECTION ON PRIVATE LANDS.

Without adequate fire protection the practice of forestry on private timber lands will not give the desired results. The leaving of seed trees and application of modified lumbering methods for the purpose of securing natural reproduction, which is liable to ultimate destruction by fire, appeals neither to the lumberman nor to the forester. Even assuming a recognized market value for young growth, there can be little incentive for encouraging or holding it as long as a constant fire menace remains; hence it follows that fire protection is a fundamental necessity in all plans for forest management on private holdings. Definite plans for fire protection should precede or accompany all working plans for forest lands, and in most cases fire plans alone will give results which will fully justify their application.

It is surprising that individual timber owners have done so little for themselves in matters of fire protection, especially in view of the fact that it is largely a local problem, and can be most satisfactorily dealt with as such. Adequate protection is undeniably a complex and difficult task. It is, however, no greater than many of the logging, milling, and transportation difficulties which have been successfully surmounted. It has been neglected merely because financial success has not been dependent upon it. The enterprise and ingenuity of American lumbermen is world renowned. For the cheap and rapid manufacture of lumber they have developed marvelous mechanical devices. But in matters of fire protection they are still little farther advanced than were the pioneers of the industry. Indeed, by opening up the forests and leaving large quantities of inflammable débris they have rather increased the fire danger. As it was fifty years ago, so it is to-day. No attention is paid to fires until they reach dangerous proportions; then they are fought with characteristic American energy; the mills are often

shut down, all available men are employed to fight the flames, and the fire is usually controlled, but at great expense. The more rational and businesslike and in the end the more economical method, systematic preventive measures and preparation for promptly extinguishing small fires, has seldom been employed.

NEW DEPARTURES IN DEALING WITH THE FIRE PROBLEM.

In keeping with the changed conditions already mentioned, the result of which must be to compel a departure from the old methods made possible by an abundance of timber, there has of late been evinced a growing disposition to introduce fire protection on forest lands. This has taken the form, in some cases, of actual attempts to prevent fire from running through mature timber or young growth and to reduce the fire danger by carefully burning slash. The greatest difficulty at present is lack of knowledge of how to attain these ends.

BURNING SLASH.

Several lumber companies in various regions have attempted to burn the slash on cut-over land, but have not developed a wholly successful system. The owner of an enormous tract of virgin timber in northern California, Mr. T. B. Walker, has employed men to rake away the débris from the larger sugar and yellow pines and to throw fresh dirt into the cavities previously burned in the bases of the trunks. (Pl. II, fig. 2.) The same plan has been tried on a small area of longleaf pine near Ocilla, Ga. Such a procedure will give temporary protection from surface fires, but it leaves all young growth open to destruction and does not get at the root of the evil.

During the past year the Bureau of Forestry has made a special study of slash burning, and of forest-fire protection in general, on private land in California. The idea has hitherto prevailed that in order to burn slash successfully the tops must be lopped and the limbs and other débris piled. This has made the process too expensive for general adoption. Experiments are now being made to prove the feasibility of burning the slash as it lies. It is thought that by selecting favorable weather conditions and burning in small blocks or broad lines the fire can be easily controlled. Promising clumps of young growth and seed trees will be protected by clearing around them before the fires are started. Under no condition should there be indiscriminate firing of slash, regardless of method, and without competent supervision. (See Pl. III.)

PLAN FOR PROTECTING MATURE TIMBER.

On the California timberlands of a match company a plan of fire protection prepared by the Bureau was in operation during the past year. The results at the close of the first season were very satisfactory. No

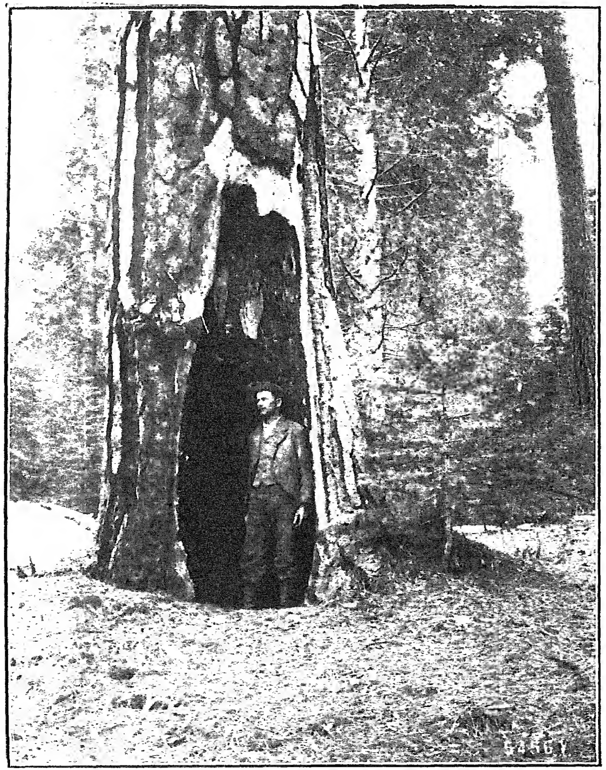


FIG. 1.—BURNED-OUT BASE OF LARGE YELLOW PINE (PINUS PONDEROSA). FRESNO COUNTY, CAL.

[Marks of at least two fires are seen in this tree. On the ground is a mass of inflammable needles.]

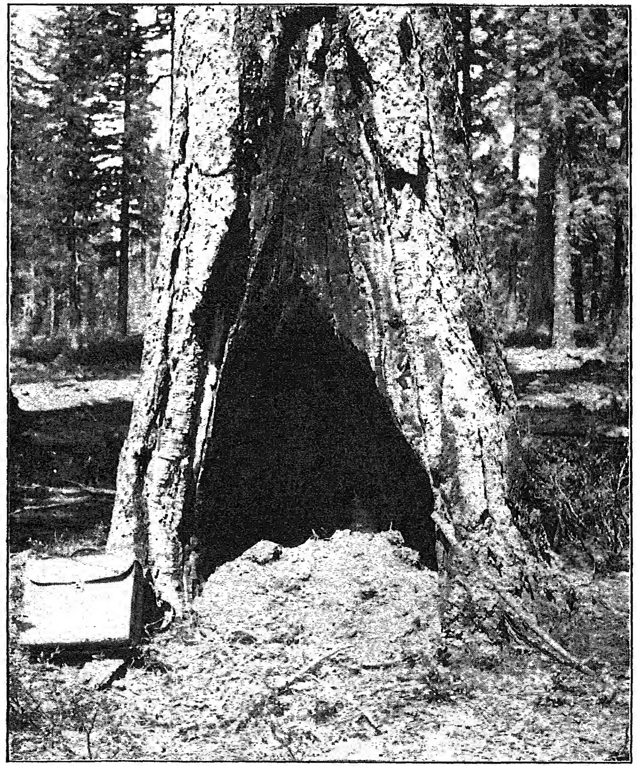
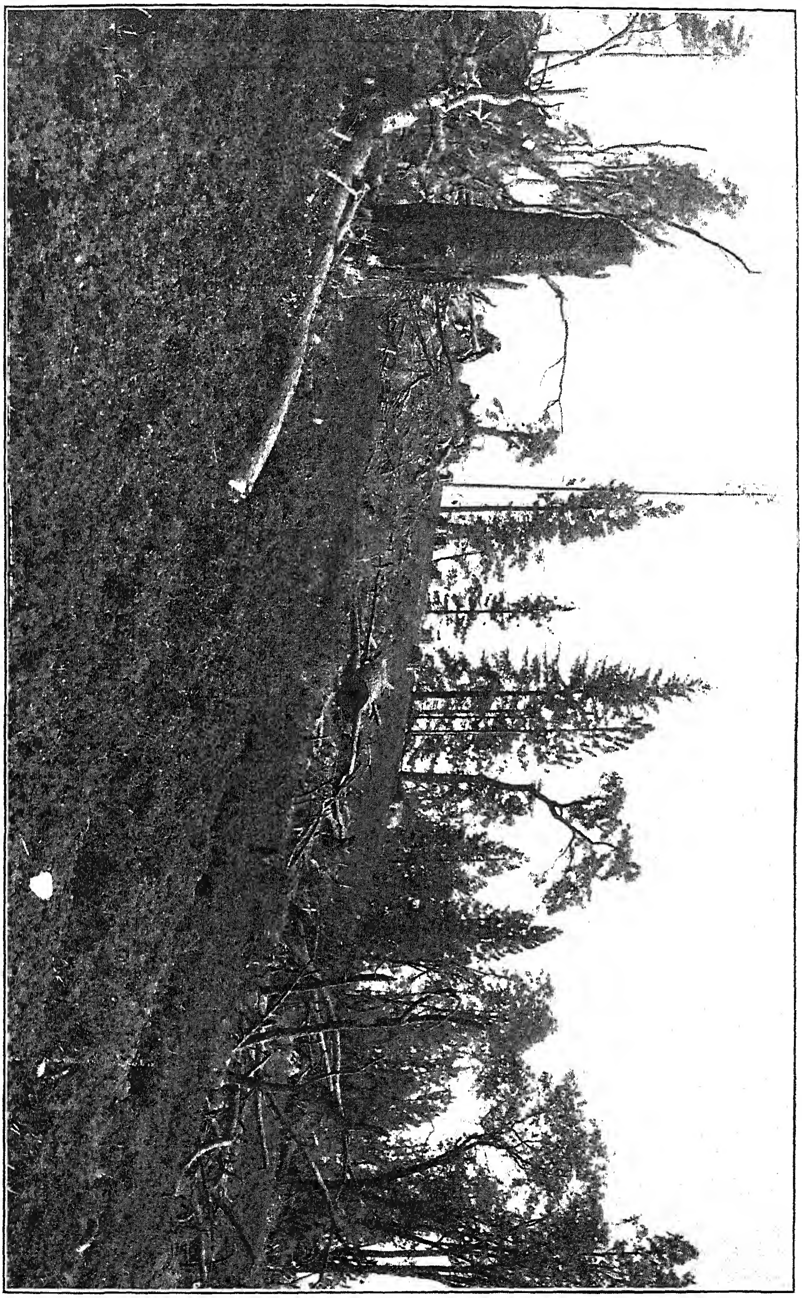


FIG. 2.—SUGAR PINE BURNED OUT AT BASE, SHOWING FRESH DIRT THROWN IN TO PREVENT FUTURE FIRES FROM REACHING BURN. SHASTA COUNTY, CAL.



CLOSE CUT IN OPEN PINE AND FIR FOREST, SHOWING SLASH IN FOREGROUND. MADERA COUNTY, CAL.

serious fires occurred, a marked contrast to the record of recent years prior to the application of the plan. In addition to an annual systematized burning of the slash on the land logged during the year, the plan provides for a system of trails and telephone lines, whereby all fires may be reported and reached promptly, a lookout station at a commanding point of view, a regular patrol during the dry season, the posting of warning notices, the storing of fire-fighting tools at convenient points, and the working up of an antifire sentiment among employees and local inhabitants. With the growing desire for fire protection, the general practices here found successful should, with modifications to suit local requirements, find application elsewhere.

THE QUESTION OF SECOND GROWTH.

Assuming that the lumberman finds it advisable to protect his mature timber and burn his slash, the question arises: Can he afford to protect the young growth on his cut-over land, or to hold the land for the second crop? It is an undeniable fact that young forest growth in general has no sale value, although in the eyes of the forester its prospective value is considerable. It thus follows that under the present system of taxing forest lands, and in the face of a constant fire danger, there is little encouragement for lumbermen to hold second growth or to invest money in its protection. Despite these discouraging facts, many lumbermen are retaining their cut-over land and manifest a desire to preserve the second growth. But no active measures to protect it have been taken, except in a few cases, such as those just mentioned. It is not so much the uncertainty of returns as the danger that all will be lost by fire that prevents the general retention of lands more suitable for timber production than for agriculture.

SUMMARY.

In conclusion, it may be said that economic conditions produced by an overestimated abundance of timber have been mainly responsible for the hopeless, inactive attitude of lumbermen toward forest fires. They have been tolerant of, rather than aggressive toward, this greatest of forest evils. In keeping with the more recent changes in the lumber market, and as one of the ameliorating influences of the application of forestry to the lumber industry, there has come a greater desire for the protection of private timberland from fire. That this need has not been met more promptly has been due largely to a lack of knowledge of how to proceed. Adequate forest-fire protection is a big and difficult undertaking at best, but if approached as such, and if serious, systematic action is taken by individual lumbermen, the solution will be found. The desired end, if attained, will

ultimately justify the expense. The State and Federal governments can contribute to the attainment of satisfactory results by new and revised forest-fire legislation and by giving expert advice to those desirous of it.

With the general application by State and private owners of successful systems of forest protection will come a new era in American forestry. As the fire risk is reduced timber-producing land will become more desirable property, the potential value of young growth will be recognized, and a long step will be made toward putting the lumber industry on a more enduring business basis.

RELATION OF WEATHER CONDITIONS TO GROWTH AND DEVELOPMENT OF COTTON.

By J. B. Marbury,
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GENERAL REMARKS.

The peculiar adaptability of the climate of the South to the production of cotton, the great clothing staple of the world, has made this the "money crop" of those States lying within what is known as the Cotton Belt of the United States. This belt includes the States of North and South Carolina, Georgia, Alabama, Mississippi, Louisiana, Arkansas, and Texas, and portions of Tennessee, Florida, Virginia, and Oklahoma. In the present study of the subject the last four States have been left out of consideration, since the output from each is relatively small and data from the sections of those States devoted to the cultivation of cotton are difficult to obtain.

Cotton, though a sensitive plant, is of all summer-growing crops of the South about the least affected by ordinary changes in the weather. Its long period of growth, fruiting, and maturity affords it ample opportunity to recover from a number of temporary setbacks. During the protracted season from planting in April to the completion of its harvest in November it is exposed to many varieties of weather, and it seems to endure the bad as well as enjoy the good. Such a thing as "half a crop" is unknown. Statistics show that the crop is seldom curtailed by more than one-fourth or one-third.

It being a well-established fact that the temperature and the amount and distribution of rainfall are vital factors in the growth and maturity of all crops, a careful study of these elements in conjunction with the average yield of cotton per acre for each year since 1893 has been made, and the following results deduced as to the weather conditions most favorable for the growth and development of this important crop.

INFLUENCE OF MOISTURE IN DEVELOPMENT OF COTTON.

During April, the month of planting, there should be frequent but comparatively light showers to keep the soil in good moist condition, favorable for germination. Should the soil become heavily charged

with moisture while the seeds are in the stage of transformation just prior to germination, decay will result; on the other hand, should the ground become dry and baked, the seeds will not obtain the required nourishment to start growth and but few plants will come up. If the nights are cold, even though the moisture element is just right, germination and growth are seriously retarded. Long experience has taught the planter not to put the seed in until the soil has become warmed by the spring sun, when the warm days far outnumber the cool ones. While temperature and precipitation are each prominent factors in the growth of all plant life, the latter seems to be the stronger influence in the development of the cotton plant. Well-distributed showers during the spring months serve to keep the soil in a condition well suited for the best development of the young plant and to cause the roots to sink deep into the earth, thus enabling the plant to maintain itself against the dry periods of the following summer. A very wet spring causes the development of a large number of surface roots to the sacrifice of those roots which naturally tend downward, and the droughty conditions which prevail frequently during the summer soon cause the plant to wilt and shed its foliage and fruit, since the dry surface soil does not furnish sufficient nourishment for its growth. The following extract on the importance of moisture in the life of the plant is taken from Johnson's "How crops feed:"

> Let us suppose dew or rain to have saturated the ground with moisture for some depth. On the recurrence of a dry atmosphere with sunshine and wind, the surface of the soil rapidly dries; but as each particle of water escapes (by evaporation) into the atmosphere, its place is supplied (by capillarity) from the stores below. The ascending water brings along with it the soluble matters of the soil, and thus the roots of the plants are situated in a stream of their appropriate food. The movement proceeds in this way so long as the surface is drier than the deeper soil. When, by rain or otherwise, the surface is saturated there is no longer any ascent of water; on the contrary, the water, by its own weight, penetrates the soil, and if the underlying ground be not saturated with moisture (as can happen where the subterranean fountains yield a meager supply) then capillarity will aid gravity in its downward distribution. * * * It is easy to see how, in good soil, capillarity thus acts in keeping the roots of plants constantly immersed in a stream of water or moisture that is now ascending, now descending, but never at rest, and how the food of the plant is thus made to circulate around the organs fitted for absorbing it. The same causes that maintain this perpetual supply of water and food for the plant are also efficacious in constantly preparing new supplies of food. * * * The more extensive and rapid the circulation of water in the soil, the more matters will be rendered soluble in a given time; and, other things being equal, the less will the soil be dependent upon manures to keep up its fertility.

INFLUENCE OF SUNSHINE ON YIELD OF CROP.

The charts for April and May (figs. 1 and 2) reveal the fact that both months are comparatively dry, the normal precipitation of neither being

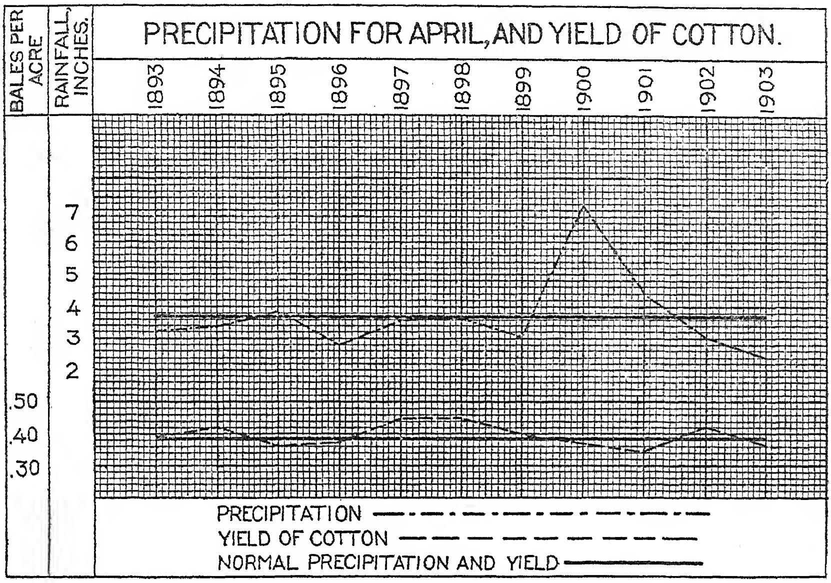

FIG. 1.—Comparison of precipitation during April and yield of cotton for the years 1893-1903, and normal precipitation and yield.

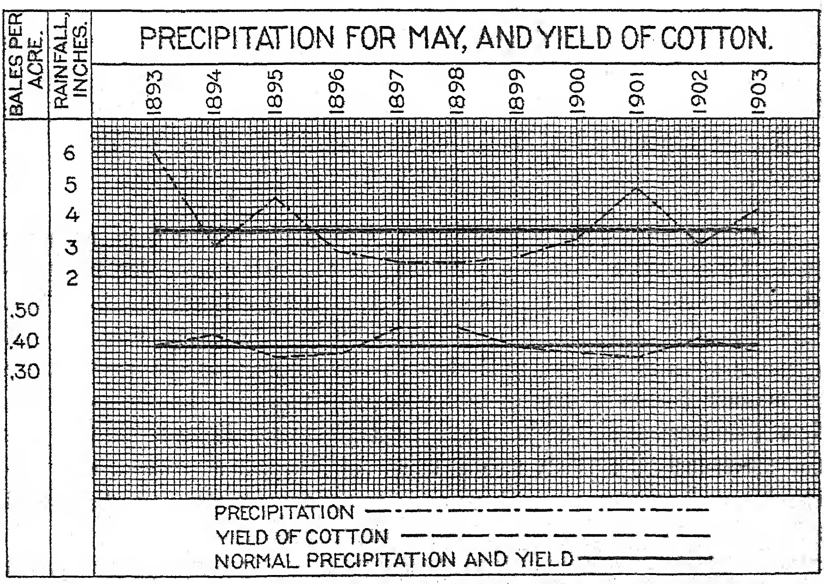

FIG. 2.—Comparison of precipitation during May and yields of cotton for the years 1893-1903, and normal precipitation and yield.

as much as 4 inches—just sufficient moisture to nourish the plant to healthy growth without an abnormal development. A small amount

of rain during May enables the farmer to clean out the weeds, and at the same time promotes a healthy, but not too rapid, growth of the cotton plant. This plant is a great lover of warm sunshine, needing during its entire life plenty of warm, sunny days and warm nights. It is said to thrive best in a climate where the rays of the sun strike the earth almost vertically.

The time required for the full development of cotton is about seven months from the time the seed is placed in the ground to the time the staple is ready for the gin. This period should have a large percentage of sunshine and be free from damaging frosts. The growing period of cotton is from about the 1st of June to the middle of August. The blooms, as a rule, begin to appear early in June and the first bolls form about the first decade in August. During June and part of July there should be plenty of sunshine, interspersed with only sufficient rain to furnish nourishment to the plant without causing a rapid multiplication of surface roots or a too rapid development of the stalk and limbs to the detriment of the bloom and fruit. The air should be rather dry, since a large percentage of the moisture needed is supplied by the heavy deposits of dew at this season.

If the first three months have been favorable, the plant can stand considerable rain during the latter part of July and the first half of August; and, if there is plenty of warm sunshine during the last half of August and much of September, the staple will mature rapidly and a large yield will result. This is shown very plainly on the chart (fig. 7), where the rainfall for both July and August is much in excess of normal, but the records show that the rains were followed by protracted warm periods of sunshine. It was under the conditions prevailing during the year 1898 that the largest yield of cotton in the history of the South was produced, up to the close of the period covered by this article.

During the blooming period it is best that there should be no more than the normal amount of rain—about ten rainy days per month—since too much rain is likely to cause decay of the fruit and shedding. The bloom of the cotton plant opens during the early morning and remains open to the sun until late in the afternoon; the petals then close until the next morning, when they open again. The color of this flower undergoes a change from a delicate ecru to light red, and when the petals fall off a small boll is left. It is at this stage that very little rain and plenty of sunshine are required. Continuous cloudiness at this stage is very nearly as disastrous as constant rains.

The normal conditions of temperature and rainfall throughout the cotton belt are, as a rule, most favorable for the proper development of this delicate plant. April and May, with less than 4 inches of rain each, cause the tap root to sink deep into the soil, so that sufficient moisture is brought up from below to satisfy the demands of the plant

later in the season, when the weather is dry and sunshine prevails. The temperature during June and July (figs. 3 and 4) is also a very

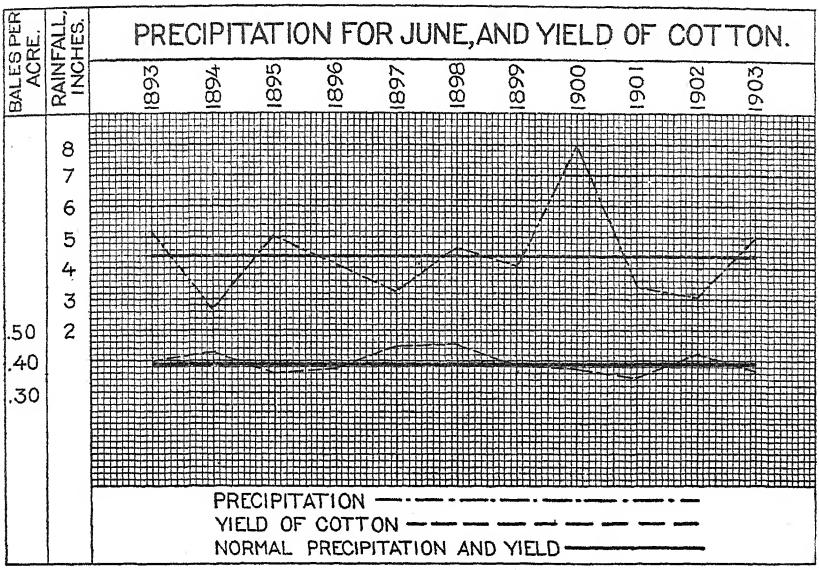

FIG. 3.—Comparison of precipitation during June and yield of cotton for the years 1893–1903, and normal precipitation and yield.

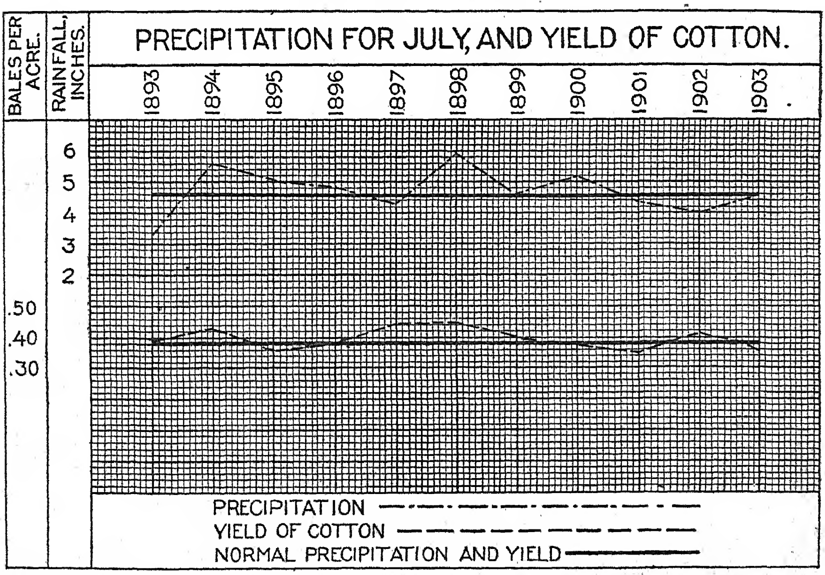

FIG. 4.—Comparison of precipitation during July and yield of cotton for the years 1893–1903, and normal precipitation and yield.

important factor, averaging about 78° for the former month and 80° for the latter. There is a marked uniformity in the average temperature among all the States in the cotton belt.

August (fig. 5) may be considered a most important period in the life of the cotton plant. About the first week in this month the bolls begin opening. From the first bloom to the first boll is a period of about

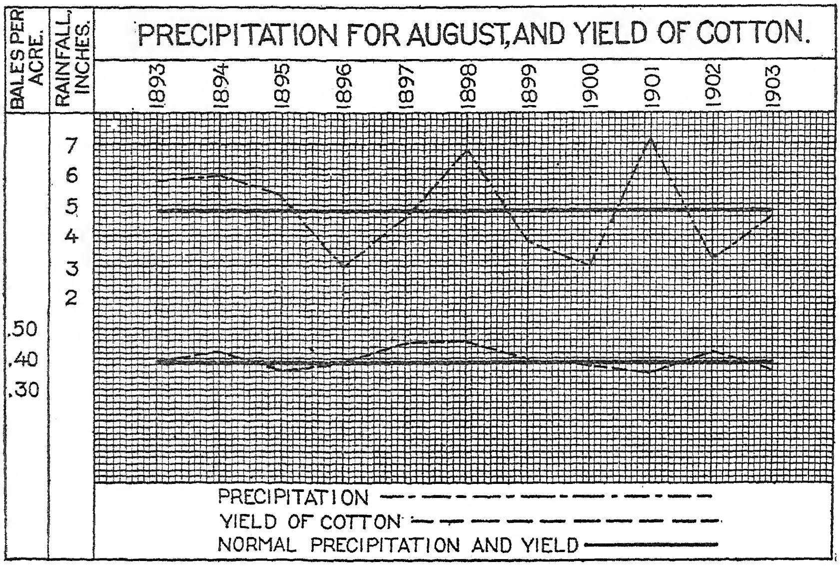

FIG. 5.—Comparison of precipitation during August and yield of cotton for the years 1893-1903, and normal precipitation and yield

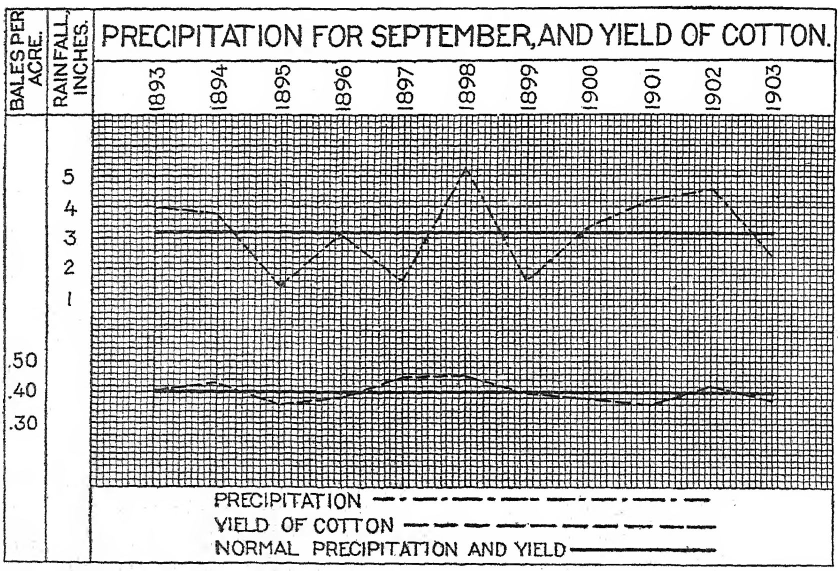

FIG. 6.—Comparison of precipitation during September and yield of cotton for the years 1893-1903, and normal precipitation and yield.

seven weeks. The plant continues growing and blooming until the new growth is killed by frost, but it does not bloom so luxuriantly as earlier in the season, since much of its vitality is needed to carry the bolls

already formed to maturity. During this period of its life an abundance of light, well-distributed showers and warm sunshine is needed. If too much rain falls, the results are peculiarly disastrous; the weed will begin to grow rapidly, to the detriment of the fruit; the plant will cease to make new blooms and the squares already formed will drop; the bolls will decay on account of the accumulated moisture which they absorb; the fiber in the open bolls will be either beaten out or discolored.

September and October are the months for picking, and, of course, dry weather is needed. Only sufficient moisture is then required to nourish the growing bolls and opening flowers, and much of this can be secured through the roots, provided the weather early in the season has been such as to cause the roots to penetrate deep into the soil. Under normal conditions the rainfall is very light during the months of September (fig. 6) and October throughout the major portion of the cotton belt, affording fine opportunity for securing the matured crop.

WEATHER CONDITIONS THROUGHOUT THE COTTON BELT.

YEAR OF GREATEST YIELD.

Figure 7 shows the yield of cotton for 1898—the year of greatest yield—together with the rainfall for each month during the season.

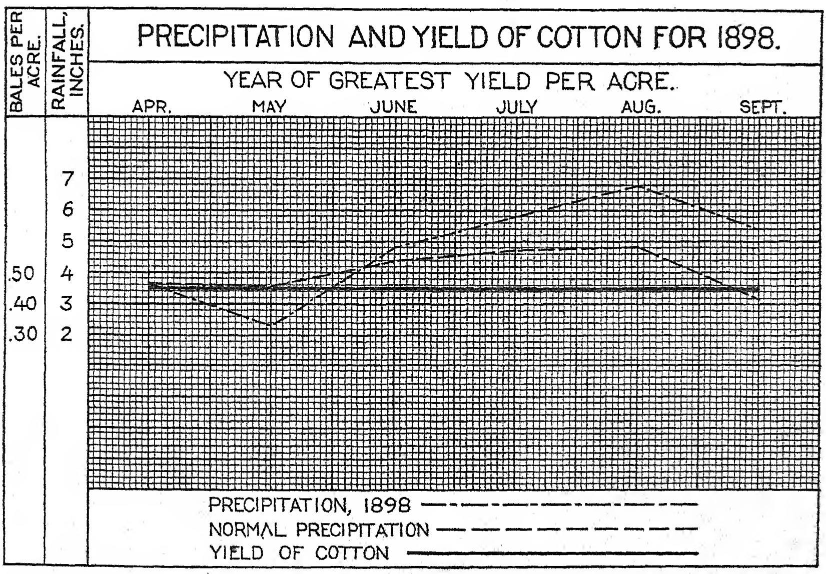

Fig. 7.—Comparison of precipitation for the growing season, and yield of cotton for 1898, the year of greatest yield in the period covered.

From this chart it will be seen that April had just about the normal amount of rain, while May was a dry month, its rainfall being 1.1 inches less than the normal. June had just about the normal amount, and it was well distributed throughout the month. July had more

than the average amount, as had also both August and September; but, coming after the plant had gotten a good start and was well worked, and being accompanied by a goodly number of sunshiny days, this proved rather a benefit to the crop. A summary of the conditions is as follows: During the first decade of April it was rather cool, freezing temperatures occurring in the northern portions of the belt and damaging frosts down to central Florida. Cotton made very little growth during the month, but the roots seemed to penetrate deep into the soil. May was particularly favorable for a rapid development of the plant. Rains were just sufficient to furnish the required amount of moisture and not to interfere with the thorough cultivation and cleaning of the fields. During June cotton made steady growth under the most favorable conditions. There was about the normal amount of rain, with just normal temperature. Considerable rain fell early in July, causing a rapid growth of the stalk, but these conditions changed before the 10th, and the dry weather following afforded ample opportunity to kill out the grass and weeds. Abundant sunshine gave renewed energy to the plant. Excessive rains early in August caused considerable apprehension among the planters, but more favorable conditions prevailed during the latter part of the month and most of September, and the result was the largest yield ever recorded.

YEAR OF SMALLEST YIELD.

Figure 8 shows the relation between the precipitation and the yield

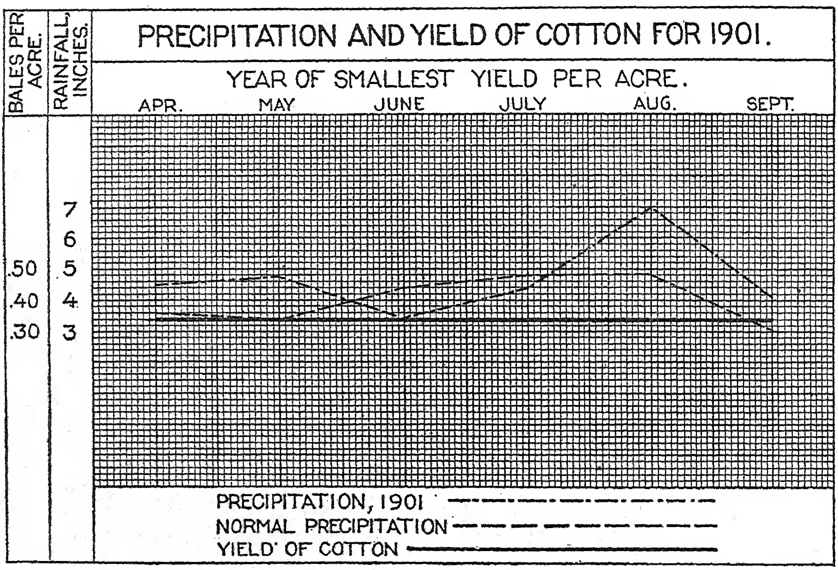

FIG. 8.—Comparison of precipitation for the growing season and yield of cotton for 1901, the year of smallest yield in the period covered.

per acre in 1901, the year of smallest output. The rainfall curve for April shows that it was a very wet month, nearly 1 inch more than

the average. In addition to this the temperature was abnormally low, averaging 5° below normal. Preparation for planting was delayed on account of the chilled condition of the soil. May was somewhat cooler than normal, with the rainfall over an inch above the average. Cotton that was planted made very slow growth; the fields could not be worked and became overrun with grass and weeds. The early part of June was wet, interrupting work and growth; the last half of the month was more favorable, with plenty of warm sunshine, but it was not until late in the month that the work of cleaning the fields was completed. July had about the normal amount of rain, but it came in the form of heavy downpours, followed by excessive heat, causing rapid shedding, rust, and bloom at the top. August had about normal temperature, but more than 2 inches above the normal rainfall. The accumulated excess of rainfall caused cotton to grow too much to weed, and the stalk was watery and unhealthy and the bolls failed to mature. Contrary to the rule, September was a cool, wet month, interrupting the ripening and gathering of the staple. On the whole there was a decided excess in rainfall and a deficiency of sunshine. From April to September there was a total excess of 7 inches in precipitation and a deficiency in temperature of 5°.

SUMMARIES FOR COTTON SEASONS.

The year 1893 gave a normal yield of 0.39 bale per acre. The weather during April was most favorable; its temperature averaged only 3° above normal, while the precipitation was just about the seasonal average. May was favorable as to temperature, but there was rather too much rain, about 2.5 inches in excess of the average; this rendered the soil too wet for cultivation and the fields became foul. The same was true as to most of June, while July had over an inch less than its normal amount of rain. The plant grew rapidly during May and June. Work was rushed and the fields were freed from grass early in July, and the abundant sunshine caused a rapid development of the bolls. August had more than the average amount of precipitation, but it was so distributed and interspersed with warm sunshine as to prove rather beneficial. Picking was interrupted many times by rain during September, but killing frosts did not occur until late and an average crop was harvested.

The year 1894 yielded more than the normal per acre, and, as is revealed by the charts, was a comparatively favorable season. April was warm, with about the usual amount of rain. May and June followed with less than the average. During these three months cotton developed rapidly and was in a condition to be benefited by the generous rains which came during July and August. September gave about the usual amount of sunshine and rain.

With the exception of 1901, 1895 gave the smallest yield per acre;

April was favorable, with about normal weather conditions, but from May to August, inclusive, the rainfall was far in excess of the normal, while the number of sunshiny days was small; as a consequence it was impossible to keep the fields free from weeds and grass, and the plant made too rank growth.

Another poor year was 1896, the yield being 0.02 bale less than the average. This shortage was evidently due to the accumulated deficiency in rainfall throughout the entire season, April being the only month with precipitation equaling the normal. The damage from lack of moisture was supplemented by excessive sunshine and abnormally high temperature. The growth of the plant was stunted early in its life and never recovered.

The yield for 1897 was practically the same as that for 1898, and the weather conditions during these two years were very similar, except that the amount of rain during the latter was somewhat greater.

A normal crop was produced in 1899. The temperature averaged slightly above normal, and the rainfall somewhat below each month. The dry weather during April and May gave the plant such a start that it was enabled to withstand the drought later in the season. Its roots were forced down into the soil, from which moisture was secured during July and August.

The crop of 1900 was slightly below that of the preceding year. The heavy rainfall and low temperatures during much of April retarded planting until late. May had about the usual amount of rain, followed by what may be termed a wet June and July. August was drier than usual, with an average temperature and plenty of sunshine.

In 1902 the yield was 0.03 bale per acre more than normal. April and May were about normal both as regards temperature and rainfall. June, July, and August followed with deficiencies in precipitation, but the rains were fairly well distributed.

The year 1903 was only fairly favorable. Too much rain during May interrupted work at a critical period. There was about an average during each of the remaining months, but unevenly distributed. The crop became very grassy in many sections early in the season, and could not be properly worked and cleaned in time to make a full crop.

INSPECTION OF FOREIGN FOOD PRODUCTS.

By H. W. Wiley,
Chief of the Bureau of Chemistry.

BEGINNING OF FOOD INSPECTION.

The act of Congress authorizing the inspection of foreign food products before entry, which went into effect on July 1, 1903, marked a new era in the progress of food control in the United States. Although authority had been given the Secretary of Agriculture in previous years, beginning with 1899, to inspect food products and refuse admission to those which were found to be injurious to health, a lack of funds prevented the inception of such inspection.

Up to that time only one article of food manufactured in foreign countries and consumed in the United States was subjected to inspection for the purpose of ascertaining its fitness for human consumption. That article was tea. Under an act of Congress of March 2, 1883, and under another act of March 2, 1897, the Secretary of the Treasury was authorized, with the assistance of certain experts appointed by himself, to inspect all teas offered for import into the United States. The language of the latter act is, in part, as follows:

An Act to prevent the importation of impure and unwholesome tea.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That from and after May first, eighteen hundred and ninety-seven, it shall be unlawful for any person or persons or corporation to import or bring into the United States any merchandise as tea which is inferior in purity, quality, and fitness for consumption to the standards provided in section three of this act, and the importation of all such merchandise is hereby prohibited. * * *

Sec. 9. That no imported teas which have been rejected by a customs examiner or by a board of United States general appraisers and exported under the provisions of this act shall be reimported into the United States, under the penalty of forfeiture for a violation of this prohibition.

Sec. 10. That the Secretary of the Treasury shall have the power to enforce the provisions of this act by appropriate regulations.

Sec. 11. That teas actually on shipboard for shipment to the United States at the time of the passage of this act shall not be subject to the prohibition hereof, but the provisions of the act entitled "An act to prevent the importation of adulterated and spurious teas," approved March second, eighteen hundred and eighty-three, shall be applicable thereto.

Sec. 12. That the act entitled "An act to prevent the importation of adulterated and spurious teas," approved March second, eighteen hundred and eighty-three, is hereby repealed, such repeal to take effect on the date on which this act goes into effect.

Approved, March 2, 1897.

THE RIGHT OF INSPECTION JUDICIALLY AFFIRMED.

Before this time it was a notorious fact that the United States was the dumping ground for unmerchantable, impure, and adulterated teas. Since the establishment, however, of the inspection of tea it has become quite impracticable to introduce into this country teas which do not conform to the standards required and authorized to be fixed by the Secretary of the Treasury. Objection was made by importers to these standards that they were unreasonable and unconstitutional, basing the claim upon the fact that Congress could not authorize any other body or person to make regulations of this kind. This question was passed upon by the different courts of the United States, and finally by the Supreme Court, which, in its decision rendered on February 23, 1904, affirmed, unconditionally, the right of Congress to delegate its authority in such matters. The language of the court in rendering its decision is, in part, as follows:

> The claim that the statute commits to the arbitrary discretion of the Secretary of the Treasury the determination of what teas may be imported, and therefore in effect vests that official with legislative power, is without merit. We are of opinion that the statute, when properly construed, as said by the circuit court of appeals, but expresses the purpose to exclude the lowest grades of tea, whether demonstrably of inferior purity, or unfit for consumption, or presumably so because of their inferior quality. This, in effect, was the fixing of a primary standard, and devolved upon the Secretary of the Treasury the mere executive duty to effectuate the legislative policy declared in the statute. The case is within the principle of Field *v.* Clark (143 U. S., 649), where it was decided that the third section of the tariff act of October 1, 1890, was not repugnant to the Constitution as conferring legislative and treaty-making power on the President, because it authorized him to suspend the provisions of the act relating to the free introduction of sugar, molasses, coffee, tea, and hides. We may say of the legislation in this case, as was said of the legislation considered in Field *v.* Clark, that it does not, in any real sense, invest administrative officials with the power of legislation. Congress legislated on the subject as far as was reasonably practicable, and from the necessities of the case was compelled to leave to executive officials the duty of bringing about the result pointed out by the statute. To deny the power of Congress to delegate such a duty would, in effect, amount but to declaring that the plenary power vested in Congress to regulate foreign commerce could not be efficaciously exerted.

SCOPE OF PRESENT FOOD LAW.

It is evident that in the inspection of food products the right to fix standards is necessary to any efficient action. If, for instance, there is no standard of purity, it is impossible for the inspector to determine in any case whether or not the article in question is suitable for importation. This point has also been covered by Congress, which has granted to the Secretary of Agriculture the right and authority to fix and proclaim standards of purity for food products in the United States. Many of these standards have already been fixed and were first proclaimed on November 21, 1903. All of the standards adopted

up to the present time are to be found in Circular 13 of the Secretary's Office, this supplemental proclamation having been made on December 20, 1904. The standards for other food products are under consideration and will be finally determined and fixed in the future. Meanwhile provisional standards have been constructed which may guide inspectors pending the final decisions in regard to these matters.

The language of the act is made to include food, drugs, beverages, condiments, and ingredients of such articles, thus covering practically all materials entering into consumption as additions to food or as condiments in food. Under the term "beverages" also it is evident are included mineral and other waters which may be offered for importation into the United States. It is thus seen that the authority for the inspection of such imported articles is of the most fundamental character, originating, as it must, in Congress, and sustained in all its fundamental principles by the Supreme Court of the United States. It is doubtless true that the efficiency of this act will only be fully manifest after many years of experience, because the complicated problems arising in connection with food inspection are of such a character that it is unreasonable to suppose they can be decided in advance, or even after one or two years of experience.

EXECUTION OF THE FOOD-INSPECTION LAW.

In the beginning of the execution of the food-inspection law an attempt was made to fully inform exporters of food products from foreign countries to the United States of the character of the inspection which it was proposed to exercise. Like information was conveyed to the importers of foods in this country. For the proper information of the exporters in foreign countries the collaboration of the State Department was secured. Through the courtesy of that Department the consuls of the United States were called upon to visé the invoices of articles exported to this country. To this end they were supplied with certain declarations which were to be attached to a duplicate of the regular invoice, in which opportunity was given to the exporter to declare the exact character of the articles which he proposed to send.

NATURE OF THE INSPECTION.

The language of the act approved April 23, 1904, under which the present inspection is conducted, requires that the Secretary of Agriculture, whenever he has reason to believe that food products are being imported from foreign countries "which are dangerous to the health of the people of the United States, or which shall be falsely labeled or branded either as to their contents or as to the place of their manufacture or production, shall make a request upon the Secretary of the Treasury for samples from original packages of such articles for

inspection and analysis, and the Secretary of the Treasury is hereby authorized to open such original packages and deliver specimens to the Secretary of Agriculture for the purpose mentioned, giving notice to the owner or consignee of such articles who may be present and have the right to introduce testimony; and the Secretary of the Treasury shall refuse delivery to the consignee of any such goods which the Secretary of Agriculture reports to him have been inspected and analyzed and found to be dangerous to health, or falsely labeled or branded, either as to their contents or as to the place of their manufacture or production, or which are forbidden entry or to be sold, or are restricted in sale in the countries in which they are made or from which they are exported."

From the above language it is seen that the character of the inspection is threefold—first, it must be determined whether the articles which are imported contain substances which are deleterious to health and which are not natural constituents of the articles imported; second, whether they are misbranded or mislabeled in any manner so as to deceive the purchaser either as to the character of the contents of the package or as to the country in which they are manufactured or from which exported; and, third, whether they are of such a character as to be forbidden entry to, or be restricted in sale in, the country where made or from which exported.

WHAT IS DONE FOR EXPORTERS.

The last clause of the law perhaps needs a word of further explanation. This country sympathizes with other countries in the efforts which they are making to improve the quality of food products and to restrict and control the adulteration thereof. Naturally, in countries where laws have been established relating to the control of foods there may be large quantities of food manufactured or on hand which can not be sold or offered for sale in the country where they are made. It is only a natural incident of trade that the owners of such foods should seek an outlet for them; in other words, send them to countries where rigid inspection is not practiced. This country, moreover, believes that the efforts of foreign countries in improving the quality of their foods should be supported by our own action. If, therefore, we should continue to accept from such countries food products that are contrary to their own laws, we should be aiding and abetting the disobedience of law in foreign countries. We discourage the shipment from the United States of food products which are of a character contrary to existing regulations in foreign countries to which they are consigned. We go further than this; we offer to examine before shipment cargoes of American food products intended for such countries, to determine whether or not they are suitable for export. We

refuse to give a clean bill of health to such food products if they are found on examination to be of a character forbidden by the laws of the countries to which they are consigned. This is done under direct authority of Congress, which says that the Secretary of Agriculture is authorized "to investigate the character of the chemical and physical tests which are applied to American food products in foreign countries, and to inspect before shipment, when desired by the shippers or owners of these food products, American food products intended for countries where chemical and physical tests are required before said food products are allowed to be sold in the countries mentioned * * *"

We thus propose to discourage in every possible way the shipment of such contraband articles of food to foreign countries. If in disregard of the provisions of our law American citizens export to foreign countries food products which are forbidden therein, they can not with any justice claim any protection from the United States, because they have neglected the very simple precaution, which it is their right to secure, namely, such an inspection before shipment as has been mentioned above.

PROCEDURE IN INSPECTING IMPORTS.

It may be of interest to give a brief outline of the manner in which the inspection of food products offered for import into the United States is effected. The law authorizes the Secretary of Agriculture to ask the Secretary of the Treasury to secure samples from any invoice of food products which he may think demands inspection. In harmony with this request the Secretary of the Treasury, through the proper officials at the ports, issues a notice of detention to the consignee of the invoice and at the same time secures the samples requested. These samples are sent to one of the three official laboratories—which are at present established at Washington, New York, and San Francisco—where the examination takes place. If the samples in question are found to be of a nature contrary to the provisions of the law, the consignee is at once informed of this fact and an opportunity is given him to submit evidence of such nature as he may desire to prove the fitness of the article for import. The evidence may be submitted either in person by the consignee or by his attorney, or in writing. This evidence is carefully considered, and every opportunity is afforded the consignee to prove the fitness of his wares for entry. If after the investigation is completed we are satisfied that the articles are of a nature which is not forbidden by the law, the detention is suspended and the articles are released, and take their usual course. If, however, the investigation shows that the articles, as had been suspected, are unsuitable for importation, the Secretary of the Treasury is requested to secure a reshipment of these articles beyond the jurisdiction of the United States. If this is not done within ninety days from

the time the notice is received, the Secretary of the Treasury, under authority of law, is entitled to take possession of the articles and destroy them.

It so happens that even with every effort which may be made to fully inform importers and exporters of the character of the law, many invoices are sent, innocently on the part of both importer and exporter, which are found to be unfit for importation. In these cases as great facilities as possible are given the importer to comply with the provisions of the law so as to minimize the extent of the delay and the loss which he must suffer. It is evident that as the experience in the execution of the law is increased and as importers and exporters are better informed in regard to its provisions they will be the better able to comply therewith. In fact, much of the friction and delay which were at first experienced in the execution of the law have been already removed, and it must be said, to the credit of the importers, that the great majority of them express themselves as heartily in sympathy with the purposes and processes of the law. It is largely by the help of the sympathetic collaboration of the importers that the execution of the law has been made as effective as it is.

THE WORKING OF THE INSPECTION LAW.

Some detailed information in regard to the character of the inspection will give a better idea of the working of the law.

OLIVE OILS.

In the matter of olive oils it was found by inspection that many of the so-called olive oils offered for import were mixed with large or small quantities of other edible oils. There are a great many vegetable oils which are excellent for edible purposes; for instance, as is well known, the purified cotton-seed oil, which is produced in large quantities in this country, is an excellent edible oil. In like manner, peanut oil possesses properties which commend it very highly as an edible product. Sesame oil, which is not produced to any great extent in the United States but is a large commercial product in southern Europe, is also an edible oil of fine quality. Perhaps the best of all of the vegetable oils other than olive is that of the sunflower seed, which, however, is not manufactured commercially in the United States, and which, in so far as is known to the Bureau of Chemistry, is not used to any large extent as an adulterant of olive oil. It is claimed by some manufacturers that the introduction in small quantities of these edible oils improves the character of olive oils. This may or may not be so, but at any rate the fact has no bearing on our own law relating to imports. It is evident that an olive oil which contains

any added portion of another oil and yet bears on its label the term "pure olive oil" or "olive oil" is misbranded, since the contents of the package are not pure olive oil or olive oil. Fortunately, chemical processes have been so refined as to enable the inspector to determine even the addition of small quantities of such edible oils to an olive oil. A great many of such invoices have been inspected and found, by reason of the false label, unfitted for importation. In order to avoid unnecessary inconvenience, in the first instance of this kind, where it was apparent that the importer was perfectly innocent of any intention to defraud, he has been allowed to relabel the packages in such a way as to plainly show that they contained a compound. This, however, was only a temporary expedient for the convenience of the importer. It will be necessary in future, in order to strictly comply with the provisions of the law, that the original label be so printed as to indicate the character of the mixture.

PRESERVATIVES IN FOOD PRODUCTS.

The attitude of the executers of the law in regard to preservatives in food products is a conservative one. Where actual demonstration or the weight of expert authority has shown that a preservative is injurious to health its occurrence in a food product is deemed reprehensible. In all cases the importers are notified of the existence of a preservative in these products, and when it is deemed injurious to health such products are excluded. In the execution of the law the tendency is to reach a point where all preservatives in food products will be eliminated. It is not regarded as necessary, in order to preserve food products, that chemical preservatives be employed, save those of a condimentary nature which have been used from immemorial times, namely, sugar, salt, spices, vinegar, and wood smoke. These are not only condimentary, but also to a certain extent preservative bodies whose presence is indicated by flavor and color, and which in moderate quantities are regarded not only as uninjurious but useful. The utility of condimentary bodies in promoting digestion is unquestioned, and hence there can be no logical basis for regarding such bodies as deleterious. On the other hand, noncondimentary bodies which do not reveal themselves by taste or odor are looked upon with the greatest suspicion. Such bodies as salicylic and benzoic acids, formaldehyde, boric acid and borax, and sulphites and sulphurous acid, are regarded as unnecessary and as positively deleterious. Such noncondimentary substances probably will be entirely excluded from food products, and their admission for the time being will be only under certain restrictions, which will preserve the public health from any appreciable injury.

PRESERVED MEATS AND FRUITS.

PRESERVED MEATS.—The question of the importation of preserved meats, other than those cured in the ordinary manner by salting, smoking, or pickling, is a matter of considerable importance. Especially is this true of comminuted meats, which by reason of their fineness of subdivision are not capable of being identified in respect of the animal from which they are derived. Practically all civilized countries now have a system of inspection of animals intended for slaughter, which to a certain extent insures the wholesomeness of the product. The character of the meats, for instance, which enter into a sausage does not appear from an examination of the package itself, and hence such bodies are open to the greatest suspicion. It is deemed advisable in these cases that the exporter should be required to furnish a certificate of inspection by official authority as to the animals from which the meats are derived. This is only reasonable, and it is not believed that such meats should be allowed to enter unaccompanied by a certificate of purity of this kind. The many cases of poisoning from trichinæ and ptomaines, due to the consumption of meats, and, especially in the case of ptomaines, of preserved meats, should render inspectors extremely careful to be certain that articles of this kind are not deleterious to health. The inspection of sausages and other comminuted meats has given greater cause for concern to the officials in charge of the execution of the law than almost any other kind of food products.

PRESERVED FRUITS.—In the case of preserved fruits it is held to be only just that they should be true to name; that they should be manufactured only from the fruit itself or the pure expressed juice thereof; that the products should contain no artificial coloring matter and no added substance save sugar; and that the sugar used should be sucrose, and not the article commonly known as glucose or some other substitute. The presence of preservatives in such food products is not regarded as necessary, since properly prepared marmalades, jams, and jellies do not require any chemical preservative to keep them in good condition.

BEVERAGES.

The question of beverages is one to which careful attention is given, in view of the fact that their labels are often misleading. For instance, in the case of imported wines which bear a name authoritatively given to wines in the countries where they are made, it is important that such wines should be true to name, and, if accredited by label to a certain vineyard, that they should be the pure, unmixed product of that vineyard. Such, unfortunately, is not always the case, and inspectors are often unable to decide simply by the appearance, flavor, and chemical composition of the wines whether or not the label is

true. To reach a just decision in this case recourse must be had to certificates of purity, obtained from the growers or makers of wines and from those through whose hands they must pass before they arrive in this country. It is not believed that it is a hardship to require such certificates. For instance, in the importation of high-grade cattle into the United States the pedigree of such cattle is required, and it seems only right that in the importation of high-grade wines a similar pedigree should accompany the invoice. What is true of wines is true to even a greater extent of brandies, whiskies, liqueurs, and other beverages of a similar character imported from foreign countries. The object in all cases is to secure honesty of labeling and purity of product in order that the people of the United States may not be defrauded in the one case financially nor injured in the other case hygienically.

EXTENT OF THE INSPECTION.

The extent of the inspection during the first year of the existence of the law is shown from the following table:

Imported food samples received by the Bureau of Chemistry and results of inspection reported, from July 1, 1903, to June 30, 1904.

Results of inspection.	Wine.	Meat.	Olive oil.	Miscellaneous.	Total.
Found contrary to law:					
Admitted with a caution, on the ground of being first offense	50	9	11	38	108
Admitted after the labels were changed to harmonize with the law	1	9	10	17	37
Required to be reshipped beyond the jurisdiction of the United States	37	2	14	3	56
Condemned, but not disposed of	4	11	2	5	22
Total	92	31	37	63	223
Found to comply with the law	776	150	476	255	1,657
Total number of samples examined from invoices detained	868	181	513	318	1,880
Samples taken from invoices not detained	300	2	3	61	366

GENERAL RESULTS.

Although the inspection of food products has not yet extended over two years, it is already seen that most beneficial results have been obtained. Fortunately, during all this time no recourse has been had to the courts, either to secure the enforcement of the act or to prevent it. In nearly all cases importers have been satisfied with the evidence furnished, and have collaborated cordially with the officials of the Treasury Department and those of the Department of Agriculture in securing compliance with the provisions of the act. It is true there has been some misunderstanding in regard to what the act means, and

this misunderstanding has been shared, to some extent, by foreign governments; but this has not interfered in any way with the proper execution of the law.

No attempt has been made to execute the law in any except the broadest spirit, and every courtesy possible within the proper construction of the law has been extended to those importers who innocently were violators of its provisions.

It is gratifying, also, to know that the exporters in foreign countries, as a rule, have been eager to learn of the exact character of the requirements of the law, and in many cases have made an earnest effort to comply with them. Nevertheless, as in all cases, there are some instances where it is evident that compliance with the law will only be secured by its rigid execution and not by voluntary action.

One unfortunate circumstance connected with the enforcement of the law is that up to the present time it has not been possible to inspect more than a very small percentage of imported products. It thus may happen that an article may be excluded at one time or at one port and the same article admitted at another time or at another port. This, of course, has the appearance of discrimination when in reality it is only a necessity that arises from impossibility of complete inspection.

OPPORTUNITIES IN AGRICULTURE.

I. GROWING CROPS UNDER GLASS.

By B. T. GALLOWAY,
Chief of the Bureau of Plant Industry.

INTRODUCTION.

With the rapid growth of population and the shifting of industrial centers there have been constant changes in agricultural practices. A study of the world's history shows that while agriculture has been, and will continue to be, the primary basis of wealth, it has reached its highest development where most closely allied with the factory. No country can continue to be prosperous where agriculture is the sole dependence, nor can any country hope to be independent and enjoy the best fruits of its industry where manufacturing constitutes the chief source of wealth. The farm and the factory must go side by side in order to bring about the greatest progressive, intellectual, and industrial development.

Within the last decade there has been an enormous increase in our manufacturing interests, so that it is not surprising to find that the output from the factory now constitutes 65 per cent of our annual production of wealth. A study of the figures presented to us in the annual reports of the Department of Agriculture and other branches of the Government dealing with statistical matters shows that coincident with the development of factories in a community there has been a corresponding increase in the value of farms and farm lands, as well as of the products of the farm. The great era of manufacturing upon which this country is now entering is bound to have a beneficial effect upon agriculture, for aside from the great possibilities of agricultural development alone, without reference to other industries, it is clear that as factories continue to increase in number and enlarge their output, agriculture must necessarily grow to meet these conditions.

PROBLEMS FOR THE AMERICAN FARMER.

Nearly all of the best arable land of the country has now been taken up, and those who are most vitally concerned with soil production realize that henceforward the main problem for the man who intends to make cultivation of the soil his occupation will be not so much a question of greater acreage as of greater production from a given acre. If America hopes to continue her phenomenal development,

she must be able to produce not only the enormous quantities of food required for her own increasing industrial population, but a large share of the food for other nations as well.

The average production of wheat in this country is little more than 12 bushels per acre; for corn, the average production is 25½ bushels per acre; for oats and barley, the average production is 28 and 26 bushels per acre, respectively. During the past thirty years there has been a constant variation of these averages for different parts of the country. In the great grain-producing areas of the West the average has been decreasing. In certain sections of the East, on the other hand, the average has been growing higher. The important work carried on by this Department, as well as by the State experiment stations, is doing much to bring about larger yields from a given acreage. A study of agricultural statistics, especially for the past twenty years, will show that where States and State authorities have been active in agricultural propaganda work, and where the experiment stations and colleges have paid marked attention to the farms and farmers' interests, there has been a material benefit, manifested directly by new methods of crop production, new industries and diversification, and marked improvement in the value of the crop for a given area.

Recognizing, therefore, the necessity for greater diversification and greater production per acre, the question arises, in what manner can this result best be brought about? With the increasing growth of our cities and the accumulation of great numbers of people in comparatively small areas, with the extension of railroads, telephone and telegraph systems, rural free-delivery, and trolley lines, there will be an increasing demand for many agricultural products which must of necessity be grown by intensive methods; that is, such products will be of a more or less perishable nature, and for this reason they will have to be grown comparatively close to where they are to be consumed.

This necessarily gives rise to another proposition, namely, that to grow crops close to the point of consumption requires their production on land in the immediate vicinity of cities and towns, the value of which is greatly above that of the average farm lands. The more valuable the land the greater the need for economizing every foot of it and the greater the need for thorough knowledge of all the factors governing plant growth.

The population of twenty of our largest eastern cities and their contributory territory will aggregate 15,000,000 people. Both population and wealth are constantly increasing, and in consequence there is a growing demand for something more than the mere necessities of life. Fruits, flowers, and vegetables are needed to meet the requirements of life, and these, to be furnished at their best, must be grown for the most part close at hand and produced in such a way that the largest return can be secured from a given area of land with a minimum risk.

To accomplish this result it must be practicable to control to a large extent climate, soil, moisture, temperature, and, in a measure, light. The only way this can be done successfully and practically is through the medium of glass houses.

A few years ago structures of this kind were looked upon more or less generally as a means for supplying the tables of a comparatively few wealthy private individuals or to serve for the growing of ornamental plants which had no strictly economic value. At the present time this view of the subject is rapidly changing and the time has come when the construction of glass houses and the production of plants under glass are regarded much in the same light as the development of manufacturing interests in a large factory; in other words, a modern greenhouse establishment is so handled at the present time that in many respects it is a factory, utilizing nature's forces in a way to reverse the seasons for the purpose of converting into wealth the products of the soil.

What are the possibilities in this field, and what are the steps in beginning a work which, of necessity, must be of the most intensive kind?

THE MAN FIRST.

There is a great deal being said and written at this time about farming as a vocation. Many inducements are being held out to city people and others, and many erroneous statements are being made as to the opportunities in this field. Unquestionably, there is need for pointing out the advantages of rural life, but, like all good things, the tendency sometimes is to carry the argument too far, and this results in inducing many people to go into the country or to undertake farm life who are wholly unfitted for the work. The city man is often misled by statements written by those who are not thoroughly conversant with the facts, and, again, by those who have interests at stake and who would directly benefit by inducing the prospective farmer to invest in land. It would seem well, therefore, to caution the reader on this one point and to lay before him plainly the facts in reference to some of the more important requirements in the matter of undertaking the lines of work to which we shall refer farther on.

In such intensive work as must necessarily be carried on in connection with the growing of plants under glass it is essential that the man who is proposing to undertake it should be in the prime of life. It is not work for men beyond middle age, nor is it work for men with weak constitutions. While the work is not necessarily heavy, it is of such a nature as to require strict attention, and while it is for the most part in the open air and therefore not as likely to bring on certain diseases as in the case of other more confining occupations, it frequently happens that exposure is required, and such exposure can only be borne by men of comparatively strong constitutions.

In addition to the foregoing, those who are contemplating work of this nature must or should have a thorough business training. More

failures result from lack of good business capacity in this field than from all other reasons combined. It frequently happens that a man may be successful in growing crops and in getting them into good condition for marketing, but through lack of knowledge or lack of ability to appreciate the main facts with reference to the commercial handling of his products he fails.

As a further necessity in this work, it should be pointed out that some experience is required—the more experience, of course, the better. It is not always practicable for a man contemplating entering a field of this nature to have had experience in intensive lines of horticultural work. If he can not get it by direct practice, he should spare no effort to find out all he can as to what others are doing; visit those who are engaged in the business; secure the various works that have been published on the subject; consult the experiment station reports; and familiarize himself in every way with what the world is doing in this field. If he will do this, and if he is a man of keen perception and observation, he will soon be able in a measure to manage his own affairs.

So much, therefore, for the man. The fields that are open may be considered under several heads: General plant growing; special fields, as vegetable growing and flower growing; and then the ultraspecial fields, as specialization with certain crops, such as roses, carnations, or violets.

GENERAL PLANT GROWING.

The field of general plant growing probably offers more opportunities than any of the others; that is, opportunities for a greater number of people. In the vicinity of every town or city having a population of from 3,000 to 10,000 there may be found in most cases good openings for the ambitious and progressive young man who desires to supply a home market with general crops which may be grown partly under glass and partly in a very intensive way out of doors. The demand in towns and cities of this size, of course, is not for any great quantity of any one thing; hence, the necessity for producing a variety, as ornamental plants for use in home yards, plants for cut flowers, vegetables, etc.—a general miscellaneous stock.

In work of this nature it is essential that the location selected be within easy reach of the business limits of the city, for the grower will have to depend largely for his trade on those who may visit his establishment. Such being the case, land must be secured, if practicable, within easy access of those who may wish to visit the place as prospective buyers.

For an ordinary establishment of this nature half an acre of ground is sufficient for a small start. An acre would be better. Due attention must be given to the location with respect to soil, water facilities, and opportunities for securing fuel and other essential things required

in general work. In most cases half an acre of ground under such circumstances can be bought for $500. To equip properly a small greenhouse would require another $500. For miscellaneous equipment, including tools, outbuildings, and stock, $200 would be necessary for a start. Thus, there would be invested in the neighborhood of $1,200. If the man himself wished to live at the place, as he should do, it would probably require from $800 to $1,000 for a home. In producing a variety of crops, as indicated above, the gross income from such a place should be at least $1,200 per annum. Practically, all the work on such a place could be done by the owner, with some little assistance from time to time in spring and fall.

The crops handled should be a general assortment of bedding plants, a small collection of ornamentals—such as palms, ferns, etc., which could be sold as pot plants—and carnations, roses, chrysanthemums, etc., for cut flowers during the winter. A considerable portion of this work can be done out of doors, the plan being to have the outdoor crops grown in such a way as to harmonize with the plans for inside work. Of course, a definite system must be followed, and this system will in a measure depend on local conditions. A few hotbeds and cold frames will add materially to the possibilities of such an establishment and will allow the owner to increase his stock considerably, especially of spring-bedding plants, which may be started earlier in the greenhouse and then moved to the frames outside as the season advances.

VEGETABLE GROWING.

Vegetable growing as a specialty is more profitable near the larger cities. Cities ranging in size from 25,000 in population upward are the ones which should be considered in this connection. The reasons for this have already been briefly alluded to, but may again be referred to here. They are, chiefly, that vegetable growing must necessarily be specialized and that there can be a demand for special crops in large communities only. Since the rapid extension of vegetable growing in the South and the better facilities afforded for the shipment of such crops as lettuce, cucumbers, etc., the field for the growth of vegetables under glass has been considerably restricted. There are still good opportunities here, however, and the larger the city the more chances there are for success. The grower in this case can sell his own crops, or he can sell them through a commission merchant or wholesale dealer in the city or cities to which his locality is tributary.

In this work larger areas of land are required. From 1 to 5 acres will answer the purpose, but for a larger business 10 acres or even as many as 20 acres may be necessary. The nature and character of the soil play an important part, and the grower should be in a situation to control the soil so far as possible; that is, he should not be so placed as to have to purchase his soil, which is an expensive item in itself, as

this takes out of his hands to a certain extent the possibility of controlling conditions. In the growth of such crops a quick, early-maturing soil is absolutely essential. By this is meant a soil readily adaptable to cultivation, that contains comparatively little clay, and that holds moisture readily and yet dries out quickly; in other words, a good, rich garden loam. The soil under glass must be changed every year and sometimes more than once a year. It is essential, therefore, to have opportunities for replenishing the soil without too much expense.

The chief crops that may be grown are lettuce, cucumbers, and tomatoes. As incidental crops, mushrooms, beets, dandelions, cauliflowers, etc., may be used. Lettuce and cucumbers, however, constitute nine-tenths of the crops that are grown in this way, and, all things considered, are more profitable than anything else in this field. (See Pls. IV and V.)

In beginning a work of this nature it is essential to consider the fact that when a start is made it will have to be on such a scale as to enable the grower to produce crops not only of good quality, but in sufficient quantity to pay a dealer to handle them. This is especially true if the grower depends on commission merchants or wholesale dealers to market his products. The first essential is to grow good crops; the second is to produce them in such quantities that the demand when once created will not fail for lack of supply. Many beginners make the fatal mistake of starting in such a way that they can not develop a good business for the reason that the supply of their product is not constant. The commission merchant or the wholesale dealer depends on a constant supply to build up his trade, and if he can not depend on the grower he, of course, can not afford to give as high prices as where the quantity to be had is constant. Lettuce, for example, is grown under glass usually from October until March, three crops being produced in this time. The first crop should be on the market by Thanksgiving Day or earlier, and there should be a steady supply through the rest of the season until the middle of March. If the grower, having produced a good product, has found a ready market for it, he will lose it if for any reason his supply stops for a week or ten days or two weeks during the actual season of demand. This will hold true for all other crops.

To start in work of this kind on the basis of 5 acres would require something like the following as an outlay:

Five acres of land, at $250 per acre	$1, 250
One greenhouse, 20 by 100 feet	1, 200
Hotbed, sash, and miscellaneous equipment	550
Total	3, 000

The intelligent grower, conducting his work in a proper manner, planning well and using good business methods, should be able to secure from this amount of land and glass a gross income of from $2,000 to $3,000 annually, or a net income of from $1,500 to $2,000.

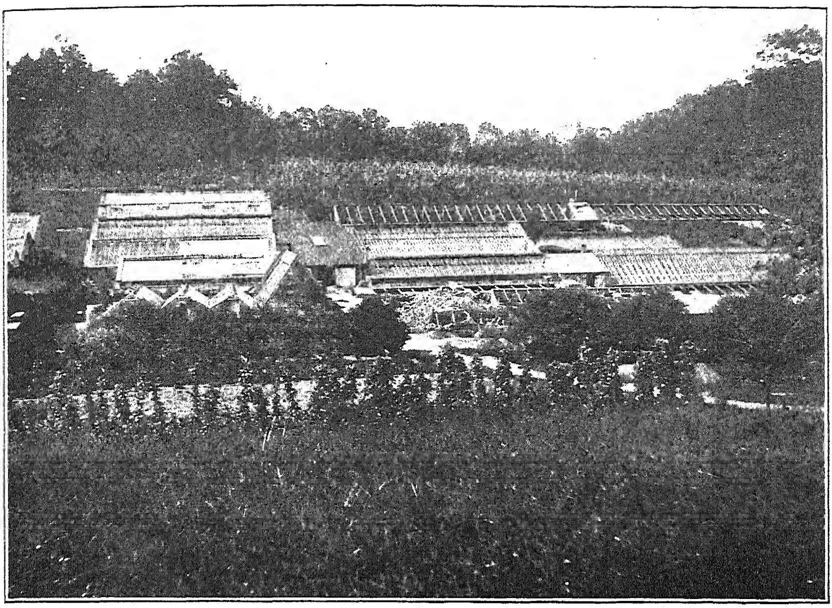

FIG. 1.—MODERN GENERAL ESTABLISHMENT, SHOWING ARRANGEMENT OF HOUSES, HEATING DEVICES, ETC.

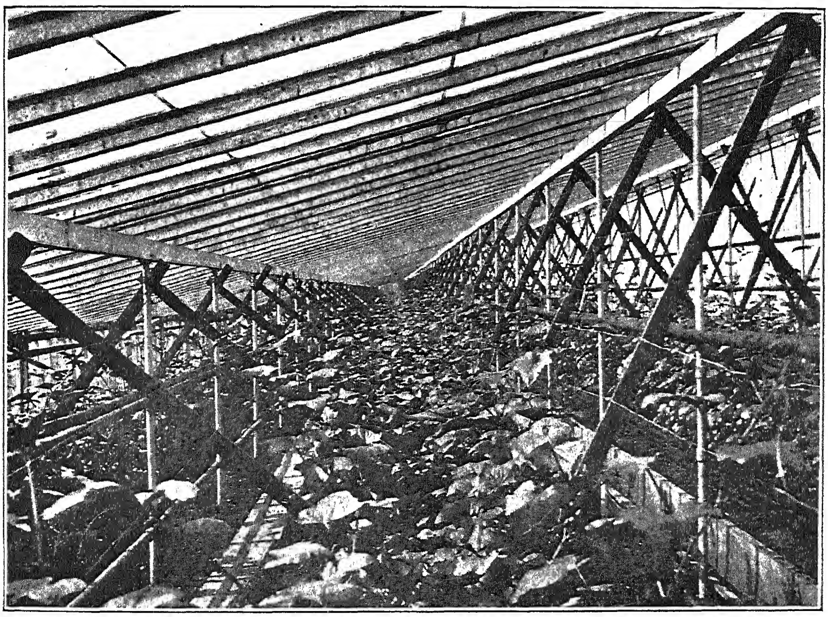

FIG. 2.—INTERIOR OF MODERN CUCUMBER HOUSE, SHOWING METHODS OF PLANTING AND TRAINING.

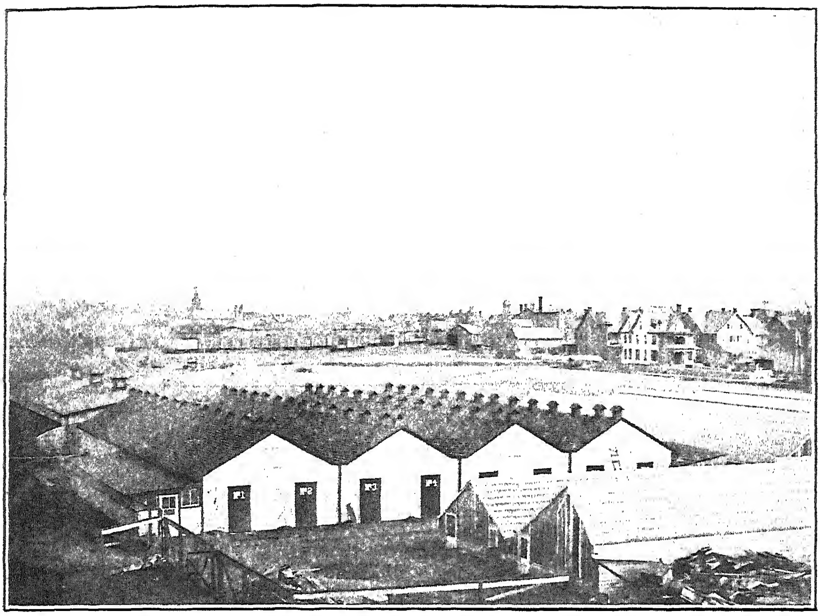

FIG. 1.—MODERN MUSHROOM ESTABLISHMENT, SHOWING SPECIALLY CONSTRUCTED HOUSES.

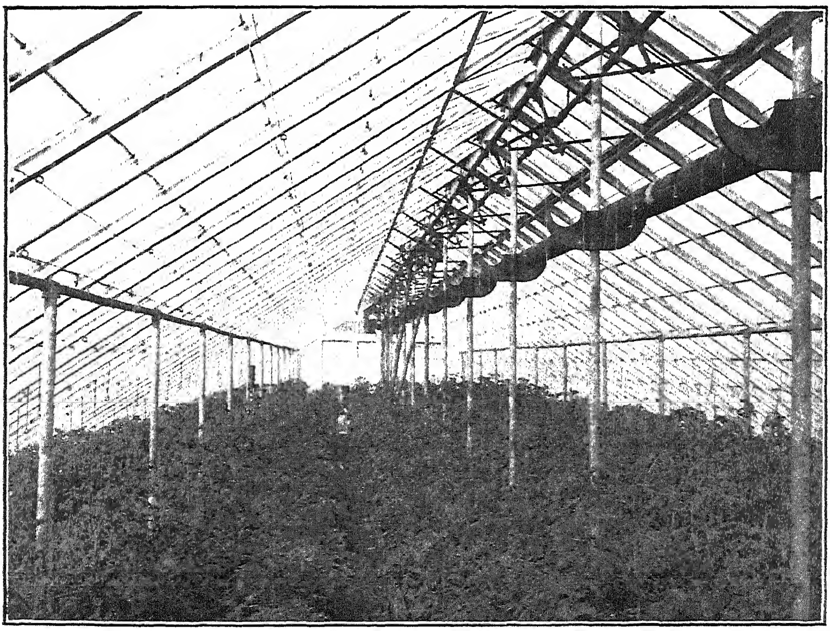

FIG. 2.—TOMATO HOUSE, ILLUSTRATING METHODS OF FORCING WINTER TOMATOES.

CUT-FLOWER GROWING.

Cut-flower growing is the most profitable field in the growing of plants under glass. It is most profitable for the reason that there is a greater demand for cut flowers than for vegetables, and while the risks in some cases are greater the profits are correspondingly large. The work in this field may be of two kinds—the growing of mixed crops, or specialization with one crop alone.

By mixed crops is meant the growing of three or more crops of flowers, such as roses, carnations, violets, and chrysanthemums. In this field the best openings are to be found near cities with a population of from 10,000 to 50,000. There is always a demand in cities of this size for cut flowers, and this demand is frequently increased if there are any special institutions in or near such cities, such as colleges, universities, etc.

The grower here may either handle his own products or sell direct to dealers in the cities. It is more profitable, if capital can be secured, to handle one's own products. A store in the town or city eliminates the middleman and enables the grower to take not only the profits from the growing of his crops, but the commissions which must be paid for selling the flowers as well. These usually represent about 100 per cent. In other words, the crops which the grower sells to the retailer in the city are sold by the latter at about 100 per cent advance over the prices paid to the grower. Considering the extra expense of store rent, clerk hire, etc., a considerable portion of this profit may just as well be secured by the grower, if he has the business capacity and can manage the details connected with both the city department and the producing department.

Moreover, this field offers opportunities for those who for various reasons can not obtain sufficient ground very near to a city. In other words, flowers such as have been mentioned grown under glass may be shipped with perfect safety from 50 to 300 miles, thus broadening the field of the prospective grower. This makes it practicable to secure land at very reasonable prices; but in addition to this must be considered the extra expense of express and freight rates both in the transportation of the crops produced and in the transportation of the material actually required for the work, such as fuel, manure, etc. Ordinarily, however, many choice locations can be found in the vicinity of a city where half an acre or an acre of ground can be secured at a price of from $250 to $500 per acre. It is not always practicable, however, to secure land as reasonably as this; more often, half an acre of such land will cost $500.

Starting with such an area of land, three houses may be constructed, each at a cost of $1,000. In these may be grown roses, carnations, and violets. In this connection it is necessary to emphasize the fact

that these crops can not be successfully grown all in the same house. Each requires a special temperature and special treatment, and hence the necessity for division of labor. With the land costing $500, three houses, $3,000, general equipment, $500, and a home for the grower costing at least $1,000, we have an investment of $5,000. The gross income from such a place should be at least from $3,000 to $3,500 annually and the net income from $1,800 to $2,000.

If such an establishment is rightly planned in the beginning, it may be extended until the entire half acre is covered with glass. In such an event, of course, the grower will have to depend entirely on the outside for his soil and manure, but this is not a difficult problem in the vicinity of a city. The gross income from such an establishment should be from $10,000 to $12,000 and the net income from $3,500 to $4,000.

Specialization in this field will be conducted in about the same manner as already described, except that the grower will limit himself to one crop, such as roses, carnations, or violets. (See Pl. VI.) There are some advantages in this and some disadvantages. The advantages arise chiefly from the fact that it seldom happens that all three crops fail in one season, while it sometimes occurs that one crop, for reasons which can not well be controlled, either falls off materially or else fails completely. A complete failure, however, is or should be very infrequent unless through bad management or lack of knowledge on the part of the grower. Specialization offers opportunities for growing crops of the highest quality and for competing in the market for the very best prices. The cost of such work is practically about the same as for general flower growing, already described. The opportunities, however, are more restricted, for the reason that to compete in this field one must grow the very best material. In other words, to be a specialist means the growing of the very best of crops. To be a specialist, furthermore, means certain knowledge and a certain temperament which are difficult to find. The general gardener, or one who has been trained in the growing of a number of crops, very frequently fails when he attempts to specialize, because he knows too much about too many things to make a good specialist. Some of the best specialists in violet growing are men who have known little or nothing about growing any other crops, and have gone into the business from the workshop or from the farm. Going into business in this way, the prospective grower has no preconceived ideas or notions about how the crops ought to be handled; his whole mind is centered on one thing, and he is not carried away by suggestions coming to him as the result of former experience in producing other crops. What is stated here in regard to the owner is applicable, of course, to the men whom the owner must secure for his help. Given a bright, quick-witted young man, with no prejudiced views as to the growing of crops, he will in most cases make a better specialist than one who has had considerable training in general gardening work.

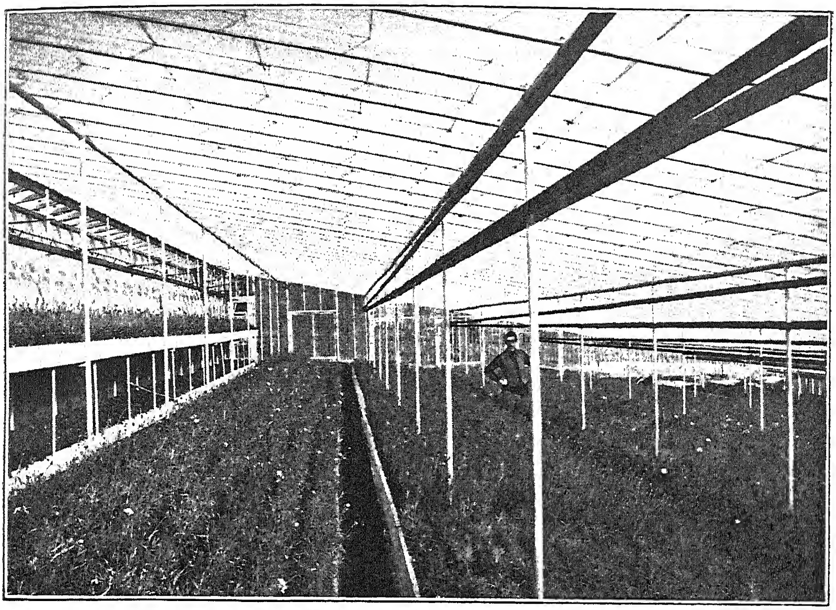

FIG. 1.—CARNATION HOUSE—PLANTS JUST SET OUT.

FIG. 2.—ROSE HOUSE AT CHRISTMAS—ROSES GROWN FOR CUT FLOWERS.

PLANT GROWING AS A SPECIALTY.

The growing of bedding and ornamental plants as a specialty is a field which is comparatively limited. The great improvement in transportation facilities has made it practicable to ship plants long distances; hence these plants are now turned out very cheaply and by the million in large establishments remote from the points where they are to be sold. Such being the case, the opportunities for the small specialist are few and are growing fewer. If the field is entered at all, it should be considered mainly from the standpoint of getting into touch with some already existing large establishment with a view to obtaining experience and with the ultimate view of pushing the business to such a point that large shipping facilities may be developed.

II. FRUIT GROWING.

By M. B. Waite,

Pathologist in Charge of Investigations of Diseases of Orchard Fruits, Bureau of Plant Industry.

INTRODUCTION.

Fruit growing in early days in this country was largely incidental to general farming. Orchards were planted by farmers whose main business was the growing of grains and cereals, live stock, poultry, etc. In recent years the business of fruit growing has gradually become a specialty. The work has been taken up by fruit men who are specialists in this line and who devote their entire energy to the growing of fruits. Among fruit growers are specialists who grow only one sort or one type of fruit, as, for instance, peaches, pears, apples, grapes, small fruits, etc. The reason for this is largely the demands of intensive methods. Intensive fruit growing requires that everything shall be done for the tree or vine that it will pay to do. The object of the intensive fruit grower is to grow the greatest amount of salable commercial fruit per acre, of the best quality which can be grown with profit. To accomplish this result pruning, spraying, and cultivating must be carefully studied and practiced, and the fruit after it is grown must be properly picked and packed and marketed to the best advantage. The successful fruit grower must be ready to utilize at all times the results of scientific investigation in agriculture. One of the most hopeful things in the recent progress of agriculture and horticulture is the utilization of scientific discoveries in practical work. The investigations of the Department of Agriculture and of the experiment stations and agricultural colleges have in no small degree contributed to this progress and to this differentiation into specialties.

REQUIREMENTS OF THE SUCCESSFUL FRUIT GROWER.

The successful fruit grower, in the first place, must be a good general farmer; he must understand all about teams, the use of tools, plows, and harrows, and the methods of preparing land, seeding, and cultivating. He should have some knowledge of chemistry, so as to know how to buy and mix his fertilizers and study the chemical needs of his crops. Knowledge of plant pathology and physiology is essential, and he must keep fully abreast with the latest methods of defending his plants against disease. He must also be enough of an entomologist to know every bug or insect which commonly attacks his crops. He should know fruits and fruit trees thoroughly, at least all the species which he grows; he must be familiar with the merits and defects of old varieties and be quick to discover the value of new ones. He must read everything published about his favorite fruit, and be prepared to sift the useful information from that which is not applicable to his local conditions. He must also be a good business man in order to buy his supplies to the best advantage and market his crops with profit. Many fruit growers have failed on account of weakness in this latter point, being unable to successfully market their fruits after they have grown them.

INTENSIVE FRUIT GROWING ESPECIALLY ADAPTED TO SMALL FARMS.

The fruit grower on a small place has certain advantages over the man who attempts to work a large area. There are several reasons for this. Most men are not able to give to more than a limited area the personal attention which is one of the great factors in success with trees and plants. Where large areas are planted much of the work must be delegated to subordinates, who usually are not equal to the owner in their attainments. With a small place under the immediate eye of the owner the various operations of pruning, cultivating, spraying, etc., may be done well and done in time. In the matter of spraying, for instance, the delay of a week may make all the difference between success and failure in preventing injuries by codling moth, apple scab, pear-leaf blight, and various other fungous diseases and insect pests of fruit trees. In the matter of cultivation, not infrequently a difference of three days, especially if an inopportune rain should come, may result in such a growth of weeds that the tools will not destroy them, and they may gain such a start as to make it unprofitable to pull them by hand, while if they are not destroyed the crop will be a failure.

The tendency of modern fruit growing, especially modern fruit marketing, is to produce sufficient quantities for carload shipments. From many localities the carload is the unit of shipment. This almost necessarily has driven men into planting on a large scale. In Georgia, Texas, and other Southern States the refrigerator carload of peaches

is the main factor of commercial success of the industry. There is no doubt a great advantage in marketing fruit, especially peaches and apples, in carload lots, and certainly the manager of a large place deserves credit for the organization and planning necessary to grow and market fruit on this scale with even a fair degree of success. He can, however, hardly hope to compete in yield per acre and refinement of methods with the fruit grower on a farm of, say, 100 acres or less. Moreover, it is not rare to find these small farmers doing a big business. There are fruit farms of less than 100 acres in several of our fruit growing sections where a business of $12,000 to $15,000 annually is carried on. These "big little farms" are really the most interesting studies in horticulture. Intensive methods are the secret of their success.

Fruit growing has always been more or less high-class farming. It has been largely undertaken by bright and observing men, who as a rule are more interested in their profession than the ordinary farmer. This does not mean that there are not capable and even brilliant men engaged in plain farming and stock raising; still, as a rule, the men who take up fruit growing as their specialty are above the average in energy and intelligence. There were some very bright and scholarly minds in the old school of horticulturists. Such men as Hovey, Manning, Wilder, the two Downings, Elwanger and Barry, and P. J. Berckmans are a credit to any profession. Few of these men grew large quantities of fruit as we estimate to-day, but they laid the foundations for modern American horticulture and gave a great impetus to fruit growing in its early days.

INTENSIVE FARMING CONTRASTED WITH EXTENSIVE FARMING.

The usual aim of the fruit grower as well as the farmer is to produce large quantities of salable produce with the least amount of labor and invested capital. In many cases, especially in opening up new countries, extensive methods were probably the most profitable at the outset. In extensive farming nature is depended on to do the greater part; man does comparatively little. In intensive methods the opposite is attempted; nature is assisted in every possible way and encouraged to do her utmost, the aim being the production of the largest quantities and of the finest quality per acre. As year after year the country becomes more thickly settled, land becomes scarcer and more valuable, and intensive methods must gain prominence. Even now we hear certain individuals criticized for attempting to farm too much land—more than they can handle profitably.

There is a good lesson in the story of the Pennsylvania farmer with a 400-acre farm who, after selling off 100 acres, found, by giving a little better attention to the remaining 300 acres, that his sales were

in no wise diminished; later, after selling off 200 acres more, and concentrating all his energies on his remaining 100-acre farm, he made it produce as much as did the original 400 acres. The writer knows of a number of instances where 100-acre farms devoted to fruit culture far exceed in production other fruit farms of 400 acres advantageously located.

POOR LAND NOT AN OBSTACLE TO INTENSIVE FARMING.

While poor soil is a great obstacle to profitable farming on extensive methods, where the land is plowed, harrowed, and planted and depended upon to produce the crop without high culture and without manures, yet with intensive farming, especially intensive fruit growing, so many things are done for the soil and for the plants that the original fertility of the soil is not so important a factor. Good soil is, of course, a great advantage for any one engaged in farming or horticulture, but convenient markets, adaptability to special crops, and other favorable conditions may often overbalance soil fertility with the high manuring and fertilizing possible in intensive farming. This should be especially encouraging to the eastern farmer whose soils are as a rule far less fertile than those of the Mississippi Valley or the far West.

INTENSIVE METHODS IN FRUIT GROWING.

Some of the details of the methods used in intensive fruit growing will now be considered.

WHAT TO PLANT.

Assuming that a fairly good location, all things considered, is available, one of the most important matters is the selection of suitable kinds or varieties of fruits. Where there are growers in the same section already engaged in the business, one should by all means study closely their mistakes and successes and endeavor to select varieties and species that succeed, for no amount of care can ever fully counteract the lack of adaptability to soil and climate so prominent with many varieties of fruits. Mistakes in planting the wrong kinds should be corrected as quickly as discovered. One of the earmarks of intensive methods in horticulture is the prompt pulling out of orchards which are a failure. Careless growers will continue blocks of trees year after year, even though they acknowledge that their planting was a mistake. The small crops obtained annually keep leading them on to spare the trees, although no profit is derived. Unprofitable trees should be either top worked to some profitable kind, if this is feasible, as with pears and apples, and even sometimes with peaches and plums; or else they should be promptly pulled out and something found to take their places.

THOROUGH PREPARATION OF THE LAND.

The thorough preparation of the land is a very important process in planting out orchards and small fruits. Frequently fruit growers are in such a hurry to plant that they are obliged against their better judgment to set out trees on ground unfitted by tillage for their reception. Trees to do their best need to have the land in a high state of culture when they are planted. It is wise, where practicable, to anticipate planting by two or three years and practice a rotation of crops which will bring the soil into perfect condition. Deep plowing can not be done in the orchard, but is by all means to be advised in the years preceding planting. The turning under of green manures and the growing of hoed crops is advisable. On rich land or new land which needs subduing, corn is a very good crop to plant. It is the best index crop known for bringing out the inequalities of the land. It will show the poor spots that need extra manure and frequently will develop the wet areas which need drainage. Cotton also answers fairly well for this purpose in the South. The best thing, however, to immediately precede the planting is some crop like Irish potatoes, sweet potatoes, or garden vegetables of some kind. Such crops bring the soil into practically a garden condition, for with them deep plowing, high manuring and fertilizing, and thorough cultivation are commonly practiced.

Subsoiling is to be highly recommended on all lands which are underlaid by a more or less stiff clay subsoil. This should be done when necessary in the fall, immediately preceding the planting of the trees. Perhaps the best way is to subsoil the strip 6 to 8 feet wide on which the trees are to be planted. Then the following fall subsoil a strip 3 or 4 feet wide on each side of this strip, and continue this annually until the center is reached. Subsoiling is particularly important, for the reason that it opens up stiff clay subsoils to the passage of the roots and deeply stirs the land in a manner which can never be done after the roots occupy the soil. However, cowpeas and clover in the orchard can produce a somewhat similar effect. One of the features of intensive horticulture is to give the trees or plants good care at the start and then to keep it up continuously.

A perennial plant, such as a tree, takes several years to recover from neglect or shock, but, if a young tree is vigorous when set out, carefully planted so as to make a fair growth the first year, and then pushed right along, it will attain a vigor and perfection not otherwise obtainable. Right here, however, a caution is necessary. The matter can be overdone. Young peach orchards especially can be pushed into such vigorous growth that they will not only "throw" their fruit, but are made tender and are easily winterkilled. In other words, vegetative vigor is so pronounced that their fruiting tendency is not

properly encouraged. The writer has seen apple orchards 15 years old, vigorous, handsome trees, and yet not in full bearing. Such trees need a moderate setback, such as may be produced by putting the land in clover for a year or two, to check them up and bring them into bearing. Once in bearing the high culture may be renewed.

THOROUGH CULTIVATION.

Tillage is the basis of all success in horticulture as well as in general agriculture—good plowing, turning over the land when it is in a satisfactory crumbly condition, not so wet as to become pasty and harden into clods, nor so dry that it will not pulverize before the plow. The skillful use of the proper type of harrow is one of the most important operations on the farm. Harrows are now made in such a great variety of styles and types that it is almost bewildering to the farmer. Nearly every one of these types has its special uses, for which it is superior to all others. The skillful farmer must keep on hand the more important types adapted to his soil, and use good judgment in sending them out to the field.

There is a great variation in the amount of culture which is deemed sufficient in the orchards of different sections of the country. One man expressed surprise that an orchard should ever have to be harrowed more than three or four times, thinking that this was the limit of necessary or desirable cultivation, and yet there are orchards which have been harrowed thirty, and even (counting the use of the weeder) fifty times in a year. However, as a general rule, if the harrowings are done at the right time, as soon as the land comes into condition after each rain, a dozen to fifteen harrowings or cultivations are about all that is necessary for complete success in growing fruit trees. Usually, however, to secure maximum results, peach orchards need to be harrowed or cultivated about once a week from blossoming time until midsummer.

GROWING OTHER CROPS IN THE ORCHARD.

Cover crops or green manures should be sown at the close of cultivation, utilizing nature thereby to grow organic manure or fertilizer in place in the soil. Some horticulturists of distinction tell us never to grow other crops in the orchard, even during the first years. The writer's opinion is that it is advisable to grow crops in the orchard during its early life, say from two to three years in the peach orchard, and four to five years, perhaps, in an apple and pear orchard. However, these crops should be in the nature of nurse crops, that is, crops which can be grown with profit and yet, on account of the culture

and fertilizing or manuring, will result in an improvement of the soil and a benefit to the orchard. Where moisture is sufficient, if large quantities of manure and fertilizer are used on crops like potatoes, sweet potatoes, sugar beets, tobacco, cabbages, beans, etc., the orchard soil may be built up and a large residual effect of manure and fertilizer obtained, which will sustain the orchard for years afterwards. The experiments at Rothamsted showed the beneficial effects of stable manure to extend over a period of twenty years. This may be followed in the later years by cover crops which keep up the supply of humus in the soil. The only difficulty with the nurse crops, and perhaps sometimes with the cover crops, is in semiarid regions, where orchards are grown without irrigation, or during a dry summer in the Eastern States, where there is not enough moisture for both the trees and the crops.

FERTILIZING.

There is an enormous difference between the quantity of fertilizer used by different orchardists in the same region. A bearing peach orchard in sections where fertilizers are used with profit on truck crops can often be maintained satisfactorily on 400 or 500 pounds per acre, costing, say, from $20 to $30 per ton. Some orchardists consider this quantity abundant; and yet it is not rare to find a thousand pounds or even more applied to some of the thriftiest orchards. As far as the writer's experience goes, the men who are making the most money are the ones who are using the greatest amount of fertilizers. Stable manure, where it is readily obtainable, is perhaps the most universally effective material for making plants grow; yet, in the orchard, this has to be used with caution. Young pear trees pushed too vigorously with stable manure are particularly subject to blight. This is true of apples and quinces to a less extent. Young peach orchards pushed too vigorously with stable manure are more subject to the peach-rot fungus, and in the far North they may be forced into a tender, late growth, which will not withstand the severe cold of winter. On the other hand, trees on light soils, especially if suffering with root aphis or other similar root troubles, can be benefited more by stable manure than by any other fertilizer. Manure is a specific for the black peach-root aphis.

FIGHTING DISEASES.

The skillful fruit grower watches his trees and plants almost daily. In fact he treasures up his experience of year after year and knows exactly when to anticipate attacks of many of the worst diseases and insect pests, and regularly prepares for them in advance. Spraying with the lime-sulphur-salt remedy in winter or early spring is now becoming very common with successful fruit growers. This is the best-known all-round fungicide and insecticide for dormant trees,

disinfecting the twigs, branches, and buds from the curl-leaf fungus of the peach, killing many Monilia spores on peaches and plums, doubtless rendering the branches impervious to the attacks of surface-growing and canker fungi, besides killing the San Jose scale, Phytoptus mites, aphis eggs, and other insect pests. The use of Bordeaux mixture, especially when combined with an arsenical poison, like the arsenate of lead or Paris green, is one of the important operations of pomaceous fruit growing. The details of this spraying can not be attempted here, but suffice it to say that the fruit grower must have a knowledge of all his suspected enemies and know how to meet them. Borers may be fought by digging away the soil from the collar of the tree and taking them out with a knife or a piece of wire. Pear blight must be fought by thoroughly cutting out the disease, first during the summer or the growing season, but mainly during late fall, winter, or early spring, when the trees are dormant. In this work a disinfecting solution should be used to keep the knife or saw free from contamination and to wash over the wounds to prevent the disease from reentering the cut surfaces.

PRUNING AND THINNING.

No one operation stands out more prominently as the work of intensive horticulture than pruning. To secure maximum results in fruit growing the trees should be pruned skillfully. The young tree must be trained into the form desired. The older tree must be kept in control by pruning. Our own preference as to the style of tree with peaches, plums, apples, and pears is the vase form, because of its numerous advantages in fighting disease, especially pear blight. Each species and variety requires more or less special study to lead it into the form most desired. As a general rule, the annual growth of the trees should be headed back to some definite length, say 14, 16, to 20 inches, regardless of the length of the top growth beyond this. However, the general vigor and future possibilities have to be kept in mind. This heading-back process will result in the pushing out of a great many twigs, making the top too thick in future years. This objection is to be met by annually thinning out first the one-year twigs, and then later, perhaps with the saw, those of the larger branches, which have not room to develop. A tree so laden with fruit that its branches are drooping to the ground may be an attractive sight; but this is not good horticulture. Partly through pruning, and more especially by thinning the fruit, the tree should never be allowed to overload itself so that it breaks down under the weight of the fruit, or even permanently bends its main branches very far from their normal position. Thinning is one of the necessary operations of any high-class fruit culture. It has been demonstrated both by careful experimenting and by practical experience to be a profitable process.

PICKING AND MARKETING.

Having grown the fruit, the next and most important part is the picking and marketing. When fine fruit has been grown up to the picking season the battle has been half won, but it has been only half won. The business side of fruit growing then begins. Markets have to be looked up, perhaps in several different parts of the country, and the telegraph and the telephone must frequently be used as the fruit attains maturity. The packages—crates, baskets, or barrels—have to be purchased and made ready for the reception of the fruit. Everything which can be done should be done to lighten the task on the picking days and to distribute the labor. This is especially true in handling perishable fruits, such as peaches, plums, and early pears. Many sorts of fruit require picking on a certain day. With peaches, they may be green one day, matured, full colored, and ready to ship on the next, and possibly too ripe and soft on the third day to be profitably handled for long-distance shipments. All this means that the grower must be ready and waiting for the fruit to mature. A well-ordered packing house that has facilities for handling, grading, and packing the fruit is a very important adjunct to every fruit farm. In fact, aside from the business office, it may be regarded as the central point of the industry on that place.

No one thing, perhaps, has more effect on the output of a fruit farm than the manner in which the fruit is graded and packed. It has been remarked that it requires an artist to select fancy exhibition fruit for the World's Fair, but this statement may be extended. It requires an artist to grade and pack fancy fruit. There are few people who really can do it, or at least few who do it. Of course, all the fruit can not be grown as fancy, and two, or sometimes three or more, grades are frequently shipped—all good marketable fruit. Near-by points can sometimes be utilized in shipping off that which is too ripe to carry long distances. Culls, bruised specimens, and wormy fruit should always be kept out of the standard grade, but they can often be utilized for canning, evaporating, making into cider, jellies, etc. At any rate, nearly all the fruit has a place somewhere, and it is the duty of the marketer to sort his fruit and put every grade in its place.

OPPORTUNITIES IN INTENSIVE FRUIT GROWING.

Naturally, in discussing the subject of intensive fruit growing the splendid opportunities on the Pacific coast—in California, Washington, and Oregon—come to one's mind. The possibilities of success have been so great, however, that many of the best locations have already been utilized and the business is highly developed. Unfortunately, the great distance from market furnishes an obstacle to profitable orcharding which at least partly offsets the natural advantages. In

Colorado, on the western slope of the Rocky Mountains, as well as in adjacent parts of Utah and New Mexico, fine opportunities await the energetic and skillful orchardist. Young orchards are being planted out at a rapid rate, and the product is, as a rule, of the highest commercial quality. The wax-like apples produced in this region, neatly packed in bushel boxes, attract buyers from nearly all the Eastern States, who paid last season prices ranging from 50 cents to over $1 a bushel for this fruit delivered at the railway stations. The future development of the apple industry in this region seems almost unlimited. Peach growing in the western Rocky Mountains is especially successful, and the output is increasing rapidly. Some of the very best sections are just now being extensively opened, and a good deal of fruit land just being brought under irrigation can be purchased at moderate prices. However, the success of this industry has caused the value of the orchard lands in convenient locations to rise to a point that astonishes the eastern visitor. Some of the finest apple orchards are valued at over $1,000 per acre.

Around most cities from the Mississippi Valley eastward there are localities naturally fairly well adapted to the growth of tree fruits. Every city of 5,000 inhabitants or more constitutes a fair market for at least one moderate-sized fruit farm. The larger cities of 25,000 people and upward, of course, offer the most attractive localities. A well-planned orchard, better still if accompanied by a plantation of small fruits and berries, can be made extremely profitable by catering to the local demand. As a rule, if the fruit is grown in large quantities it is better to sell it to greengrocers and dealers, but where the grower is prepared greater returns can, of course, be secured by marketing in a retail way.

Particularly fine opportunities for growing fruit for the local markets occur in New England. In the rush to make money out of manufacturing and trade, a large proportion of the capable young men in New England desert the farms. There are at the present time as good opportunities for brains, energy, and capacity for work to reap their reward in peach growing on some of the Connecticut hills as anywhere in the country. Frequently beautiful unused orchard sites overlook manufacturing towns having a population of from 20,000 to 40,000 people. Since the scourge of pear blight has now spread across our country to the Gulf on the south and to the Pacific Ocean on the west, we are prepared to look around and decide which region has the least trouble from this serious pest. New England and the Lake Region suffer less from pear blight than any other sections of the country in which pears can be successfully grown. A well-managed pear orchard in the vicinity of Boston, or at some other convenient point in southern New England or certain sections of New York State, and perhaps Ohio and Michigan, would be more likely to succeed than in any other part of the Union.

The largest area of undeveloped fruit country in the United States is the Allegheny Mountain region. In Maryland, Virginia, West Virginia, and North Carolina—in other words, the central Allegheny section—there is one of the finest horticultural regions in the country. By far the larger part of this is totally undeveloped. Mile after mile of beautiful mountain slopes in West Virginia are totally unoccupied by fruit plantations. This region not only has a fertile soil suitable to tree growth of all kinds, but it grows bright-colored, highly flavored fruits, especially peaches and apples, of excellent shipping qualities. They nearly always sell, when well grown, for the very highest market prices. Choice dessert apples like Grimes Golden, Rome Beauty, Winesap, Northern Spy, and, in the higher altitudes, Spitzenberg, grow readily in this region. It extends northward well into Pennsylvania and southward, as far as peaches are concerned, into north Georgia and Alabama. The mountains of North Carolina are the southern limit of good apple culture in the East. A certain section of Virginia, within this region, grows to perfection the famous Newtown Pippin, which is marketed under the name of Albemarle Pippin, the most exacting in its requirements of soil and climate of all commercial apples. Much of this land is very rough and rocky, although the soil is fertile and highly adapted to tree fruits. The stone fruits (peaches, Japanese plums, and cherries), as well as apples, pears, and quinces, thrive in this section.

In the lowlands along the coast tree fruits do not do so well south of Maryland. From Maryland northward fine peach orchards have been developed in the tidewater region. However, the growing of strawberries, cantaloupes, and early garden truck can be made very profitable from Florida all the way up to New Jersey if the right man takes hold of the work. The location of these early truck farms should be determined by nearness to market or to transportation lines, earliness of location, and protection from spring frosts. There is a succession of these products marketed through the spring and summer, beginning in Florida and following successively up the coast to New York or even farther north. A similar condition of affairs exists in the Mississippi Valley, beginning at the Gulf coast and extending through Mississippi and Louisiana to southern Illinois, and ending in northern Wisconsin and Michigan.

COST OF ESTABLISHING AN ORCHARD.

On the average, it costs about $100 per acre to plant an orchard and care for it up to five years of age. This estimate does not include the cost of the land nor the residence and main buildings of the farm. It is based on an average of 100 trees per acre, the trees to cost 10 to 15 cents each, labor at $1 per day, foreman at $2 per day, man and team estimated at $3 per day. It would include a reasonable amount

of farm equipment and, with a large acreage, certain accessory buildings necessary for the business. A 100-acre orchard, therefore, would have cost, when five years of age, $10,000, and the trees would have cost $1 each. With peaches, plums, and, to some extent, with early-bearing pears this would bring the orchard into fruiting. On the other hand, apples and the later-fruiting varieties of pears would not be in profitable bearing, and probably would not be producing fruit at all. The prospective planter should keep these figures in mind, and should not undertake extensive plantings which are to be cared for properly without planning to have this amount of money available, unless he has studied the local conditions and knows pretty thoroughly that this cost can be reduced. In Georgia, with peach trees costing from 2 to 3 cents, 50-cent labor, and other things in proportion, the cost of bringing peach orchards into bearing is commonly about one-half the above estimate, namely, $50 per acre. Frequently a man with a small farm can plant out an orchard of 10 to 20 acres, care for it himself, purchase the trees at a moderate price, and, not counting his own labor, bring the orchard into fruiting for apparently no cost at all aside from the initial cost of the trees. In this case, however, the farmer's labor has been the capital invested.

On the other hand, in the Northern States, such as New York and Michigan, and in many districts of the West, this estimate of $100 an acre would be insufficient, on account of the high price of labor, cost of the trees, and amount of work required to fit the land and plant the orchard. The planting of nurse crops brings in a factor which makes it difficult to estimate the cost of an orchard, for two separate lines of business are thus carried on. The nurse crop may be, when fully successful, so profitable as to pay the entire expense of the care of the orchard and not infrequently leave a margin of profit besides.

The Georgia cotton growers have perhaps been able to grow the cheapest orchards in the country. Peach trees are planted out in the cotton land, and the ground is cultivated in cotton for two or three years, the trees being given scarcely any care aside from the cultivation of the cotton. Perhaps a little fertilizer and a dollar or two per acre in pruning would be the entire expense for care of the orchard up to 3 years of age. Of course certain orchards more carefully pruned and thoroughly sprayed involve greater expense. In Illinois, Missouri, and other Mississippi Valley States practically the same thing has been done with corn. The profits of the corn growing have made the care of the orchard practically cost nothing to the grower. These nurse crops and other crops grown in the orchard, therefore, complicate the question of cost and make it extremely difficult to estimate accurately the absolute cost of the orchard.

The above figures will be criticized by some orchardists, and it is not intended to say that orchards can not be grown at much less cost.

By purchasing inferior trees, cultivating, spraying, and otherwise caring for the orchard in a halfway manner, the expenses may be cut in two, but the profits will probably be reduced to one-fourth. The figures which have been given are based on high-class orcharding.

III. GENERAL FARMING.

By W. J. Spillman,
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INTRODUCTION.

The phenomenal success which has attended the application of science and business methods to farming in recent years, particularly since the establishment of the State experiment stations and the recent marked development of the work of the United States Department of Agriculture, has led to increased interest in farming on the part of many people who have had no experience in that industry. During the past year many inquiries have come to the Department of Agriculture from teachers, bookkeepers, and clerks in the large cities, asking for information concerning the different types of farming and the possibilities of each. For the first time in modern times there is a distinct movement of population from congested centers to rural districts. This movement is as yet not sufficient to counteract the influence of the long-established movement from the country to cities; nevertheless, it has a very important bearing on the future of agriculture in this country.

Many of those who undertake farming for the first time will necessarily fail for lack of experience and knowledge. A few will succeed. These will be men or women of unusual ability, who are willing to devote a great deal of time to a careful study of the business. Even those who have had many years' experience in farming are not always successful. The requisites for successful farming are: (1) The ability to lay plans and to execute them, and (2) an intimate knowledge both of the principles involved in growing crops and handling stock and of the business methods necessary for converting farm products into money. A good deal of the knowledge requisite for successful farming can be secured only through experience. Those without it must have a good deal of tenacity of purpose in order to live through the trying times that come while they are gaining this experience. But the rate at which men gain experience varies greatly. A great deal can be learned by reading the agricultural papers, by studying the bulletins issued by the experiment stations and the Department of Agriculture, and by studying the methods used by successful farmers everywhere. It is always unwise to enter upon a new line of business on a large scale without abundant knowledge. The inexperienced must begin on a small scale and let the business build itself. The

greatest successes will, in general, be achieved by intelligent men who begin on a small scale and let their business grow as their knowledge increases. They will in every case be students. A good many instances could be cited of men without previous experience in farming who, after one or two years' effort, combined with careful study, have made unusual success in different lines of farming. Perhaps the most important single element in the man is the ability to distinguish between a good suggestion and a poor one.

THE MILK TRADE.

PRODUCING AND RETAILING.

Of the opportunities open in the line of general agriculture, one of the most important is to be found in the retail milk trade in our towns and cities. Particularly is this the case in the South, but there are few cities even in the North that are well served with a good quality of milk. The material put on the markets, particularly in the poorer sections of the large cities and in many small towns, is of such a character as to give the general city dweller a very poor idea of the value of milk as a food. The housewife who refused to buy milk from a dairyman because she had found a thick, greasy scum on the sample he had left the day before is not a rarity. Much of the milk offered for sale is watered and is handled in such an uncleanly manner that it sometimes sours before it can be delivered to the customers. This class of milk frequently has antiseptics, such as formalin, boracic acid, etc., added to it to keep it from souring. Where milk of this kind is sold it is always easy for an honest man who understands dairying to establish a good business in a short while. At first there may be objection to his milk because of its unfamiliar flavor, but abundant experience shows that honesty in the sale of dairy products is rewarded as quickly as it is in any other line of business. The right kind of man to develop a milk trade, in the smaller towns as well as in the cities, is one who will put upon the market clean, pure milk, testing not less than 4 per cent fat, and who knows how to handle both his cattle and their products to advantage. It is safe to say that half of the towns in the United States offer good opportunities in this line at the present time. In the larger towns and in the cities there is often opportunity for building up a good trade in pasteurized milk and cream. Pasteurized milk guaranteed to contain 4 per cent of butter fat, when handled in a businesslike manner, can, in general, be retailed in the cities at 10 cents a quart. In the smaller towns it is usually difficult to sell milk for more than 6 to 8 cents a quart, which will hardly justify the expense of pasteurizing.

The income from a dairy business such as that suggested above depends so much upon the man that no definite figures can be given.

It is impossible for anyone who is not a good judge of cows to succeed in a business of this kind. A good cow may be expected to yield an average of 2 gallons of milk a day for nine months in the year, testing at least 4 per cent. The writer does not believe it is wise, from a business standpoint, for a dairyman to place on the market milk testing lower than this, and he bases this conclusion on his observation of the experience of many men who have been engaged in the dairy business. At the above rate, a cow will give 540 gallons of milk per year. If this could be sold for 5 cents a quart above the expense of delivering, it would bring an income of $108 per annum per cow. In some localities, where milk can be sold at higher figures, a larger income can be secured.

When the dairyman depends on his farm to produce most of the feed for his stock, the number of cows which may be kept is limited only by his executive ability and the area of land available. No other type of farming builds up the fertility of land so rapidly as dairying, and after such a farm has been run for eight or ten years it is usually possible, on good land, to keep approximately one cow per acre of land in cultivation. This assumes that the dairyman raises his hay and silage, and the green feed for the summer, and buys his more concentrated foodstuffs. One man with a helper can manage a 20-acre farm, carrying 15 cows and the necessary complement of young stock to keep up the herd, with a little extra labor in haying time and during the storing of silage; and one wagon and driver will easily suffice to deliver the milk from a dairy of this size. In undertaking work on the basis outlined, particularly on land that is too high-priced to be used for pasture, one should undertake to provide silage and hay or fodder for winter and either silage or green feed and some hay for the summer. In this connection the reader is referred to the article on "A model farm" in the Yearbook of the Department of Agriculture for 1903.

In the retail milk trade the cost of delivering milk is very considerable, particularly in the larger cities, where customers may be widely scattered. There is also more or less loss from patrons who do not pay. When the ticket system is used, patrons sometimes forget to put out the milk ticket for the early morning delivery. To get this ticket then requires a special trip some time during the day, which usually costs more than the ticket is worth. In conducting business of this kind, where small quantities of material are sold to a large number of people, promptness in collecting bills is necessary to success.

On account of the competition between dealers and the consequent effort to serve the convenience of patrons, it has become customary in most cities to deliver milk in the early morning. There are several objections to this practice, not the least of which is that it requires the dairyman to convert night into day. When deliveries are made in the morning, it is the custom on many dairy farms to begin milking about 2 o'clock in the morning. It has been demonstrated to be entirely

practicable, at least in the winter time, to deliver milk during the day instead of before breakfast, and when a dairyman takes good care of his milk and furnishes a quality of milk that his competitors do not furnish, he will usually be able to accustom his patrons to day delivery. This is particularly true for the winter season. In summer, on account of the rapidity with which milk sours in warm weather, it may be necessary to make the early morning delivery. In winter there is really no necessity for it except under very special conditions. It usually pays a dairyman to be perfectly frank with his patrons and to instruct them that pure milk free from antiseptics will sour unless it is kept very clean and in a cool place, and that even under the best conditions it will sour usually within a day or two after it is drawn. The patron should be instructed that this is perfectly natural and that milk that does not sour is to be looked upon with suspicion. Some of the most successful dairymen furnish their patrons with printed literature giving facts regarding the composition of milk and the care of it to prevent souring. Incidentally, this gives the opportunity of advertising one's own careful methods and the purity and wholesomeness of the product of his dairy.

MILK PRODUCTION FOR THE WHOLESALE MARKET.

Many farmers are situated too far from market to conduct a retail business in milk, who might, however, advantageously produce milk for shipment to cities. When shipping facilities are satisfactory, it is possible to ship milk 50 to 100 miles, and in some cases it is regularly shipped much farther. There is always a demand among retailers in cities for high-class milk, and they will pay a premium for rich milk that is properly cared for. Practically, every large city in the country offers opportunities of this kind to farmers who are so situated as to enjoy satisfactory shipping facilities, and the limit to the quantity of high-class milk that can be marketed at fair prices in this manner in the vicinity of large cities has not yet been reached.

FANCY BUTTER TRADE.

In the smaller towns the milk trade is limited and can easily be supplied by a single dairy. It is only in the larger cities that there is any difficulty in securing sufficient milk for the trade. Many farmers are also situated so that they can not conveniently retail their milk to patrons. Many who are thus situated will find it advantageous to engage in the manufacture of butter, particularly in those sections of the country in which creameries are wanting. The demand for high-grade butter is steady and reliable. Butter is a product which varies so much in flavor, when made under different conditions, that it is easy when a trade has once been established to hold it. A very large proportion of the inhabitants of towns and cities always call for a brand of

butter which they have found to be uniformly of good quality, and the number who would do this could be greatly increased. Ordinarily, in towns of less than 2,000 population there is not a great opportunity for building up a trade in butter at paying prices, but in towns larger than this such opportunities invariably exist. In the smaller towns it is usually possible for a dairyman, with a good reputation, to engage butter by the year at 25 cents a pound, in practically all parts of the country, and in many places at prices considerably higher than this. In cities, where there are many wealthy people willing to pay a good price for an article of established reputation, it is possible to build up a permanent trade in butter at prices ranging from 40 to 50 cents per pound.

In a butter dairy there is usually opportunity to add considerably to the income by the sale of buttermilk, though the necessity of delivering it at frequent intervals usually makes it impracticable for the butter producer to dispose of all of his buttermilk in this manner. Skimmed milk properly treated can be made into good buttermilk and usually sells at about 10 cents per gallon. Many who have undertaken to convert skimmed milk into buttermilk have failed because of a lack of knowledge of the physical character of the change that occurs in souring milk. It should be remembered that buttermilk has been churned and thus has had its curd very thoroughly broken up, usually at about the stage of sourness required to curdle the milk. If skimmed milk is put in the churn when it is just beginning to curdle and agitated ten or fifteen minutes, the curd breaks up into extremely small flakes and there is much less tendency for the curd and whey to separate than is usually the case with skimmed milk which has been allowed to sour without agitation in the churn. It might be added that buttermilk made in this manner is very little, if at all, inferior to the ordinary kind. It is possible to produce about 2 gallons of buttermilk for each pound of butter by utilizing the skimmed milk. If the dairyman is so situated as to sell all of his buttermilk at the price mentioned, the income from this source will almost equal that from the butter itself. One advantage in butter production over that of retailing the milk lies in the smaller expense of delivering the product, as butter may be delivered once a week, while milk must be delivered once or twice daily. The butter business enables the farmer to establish more convenient working hours on his farm. One very successful dairy farm known to the writer has for many years been conducted on rules which require work to begin at 7 o'clock in the morning and all work is finished by 6 o'clock in the evening, all the milking, farm work, feeding, etc., being done within these hours.

POULTRY.

Poultry raising combines very well with dairying, particularly with the production of butter, and when intelligently managed can be made highly profitable. Perhaps a larger percentage of those who have

embarked in the poultry business have failed than in almost any other line of farming. It is so easy to figure oneself rich in the poultry business that men without sufficient knowledge and experience have embarked in it on too large a scale, and failure has been practically the inevitable result. When the business is started right, so that the farmer has an opportunity to study and acquire the intimate knowledge necessary for success, it has been very profitable. Except for a few months in the spring there is a steady demand at good prices for fresh eggs, and it is possible, by close study of the business, to secure a regular supply of eggs practically throughout the year. There will usually be a slight excess in the early spring months, at which time a considerable proportion of the eggs may be used for hatching purposes, thus combining the production of broilers with that of fresh eggs. It is possible to market guaranteed eggs at from 2 to 5 cents a dozen above the market price for ordinary eggs, even in villages, and the demand for guaranteed eggs in cities is practically never met.

The profit from this business is so variable that it is almost useless to give figures. On the farm already mentioned, where the working hours are from 7 a. m. to 6 p. m., the cost per hen of conducting the poultry business for the year 1899 was $1.01. The net profit of the business was $1.81 per hen. The cost included market price for all food used, whether raised on the farm or purchased. It also included the cost of improvements in the poultry buildings and of a number of high-priced eggs for improving the breeding stock. Opportunities for carrying on the poultry business at a profit exist practically in every community in the United States.

VEGETABLE GARDENING.

The production of garden vegetables has developed greatly in recent years. This is particularly true of the region lying immediately adjacent to the Atlantic coast, extending from southern Florida to New England, and the cities of that section are now fairly well supplied with vegetables the year round. A large portion of the winter supplies are grown in Florida, and the supplies later in the season are grown farther up the coast. Just at present there is going forward an enormous development of the trucking industry along the Gulf coast, and particularly in southern Texas. So rapid has been this development that conservative men anticipate an overproduction in the near future. Whether this will be the case remains to be seen. The cities of the Middle West have heretofore been poorly supplied with vegetables in winter, and there is room for an extensive development of this industry to supply those markets.

One of the most important pieces of work to be done in connection with the development of the trucking industry at the present time is that of systematizing the production and marketing of crops of this

character. It is difficult to estimate the quantity of vegetables that would be consumed if the people throughout the country could be supplied with what they would consume every day in the year. Truck growers should organize for the purpose of studying the needs of the market and making proper arrangements to meet these needs without producing congestion in any market at any time of the year. A seminational organization for this purpose ought to be practicable. Such an organization might keep in touch with the growers and ascertain the acreage and the probable production of every crop. It should seek to control the distribution of this crop in the markets in such manner as to prevent, as far as possible, an oversupply at any point. Another great advantage that might be gained by such an organization would be the elimination of those middlemen who have frequently taken advantage of the lack of knowledge on the part of the farmer concerning methods of marketing his products, thus causing him great financial loss. Some such organization as this will certainly become necessary if the production of garden vegetables continues to increase in the near future as it has in the recent past.

In addition to the production of vegetables on a large scale for the markets of the larger towns and cities, there is room for more crops of this kind in the vicinity of the smaller towns. It is possible to meet the demands of the small towns by local production, and there are openings for truck farmers in the vicinity of many small towns throughout the country. To succeed with a business of this kind one must not only understand the production of the crops themselves, but must become familiar with the demands of local markets and arrange the cropping system so as to meet these demands. In many cases it is possible to create good markets where none now exist. Take, for instance, those districts in which there has recently been a rapid extension of the factory system, as in the Southern States, where cotton mills have been built in large numbers during recent years. These mills are operated for the most part by those who formerly conducted small farms in the poorer sections of the States in which the mills are located. They have been accustomed to plain fare and are satisfied with it. However, it is possible to create in such settlements a market for a large quantity of garden vegetables. Such a market would give a steady demand, and, while it would not pay fancy prices, it should be remembered that fancy prices are not necessary to profit in the production of vegetables by those who are thoroughly familiar with the business.

CHEESE MAKING IN THE SOUTH.

What to the writer seems one of the most important opportunities for the extension of an agricultural industry existing in this country to-day is found in the possibilities for the production of cheese in the Southern States. The investigations of several of the experiment

station workers, particularly those of Babcock and Russell at the Wisconsin station, have brought about a revolution in the cheese industry, or, perhaps it would be more accurate to say, have resulted in discoveries that are gradually revolutionizing this industry. According to present knowledge of the manufacture of cheese, ice and even cold water are not actual necessities in a cheese factory. When the milk is delivered at the factory it is immediately heated, the rennet is added, and the temperature is further raised to cook the curd. When the whey is removed the curd is kept warm and is not allowed to cool until it is ready to go to press, and even then the temperature is usually not less than 75° F. After remaining in press overnight it may be removed and shipped immediately to the cities and placed in cold storage.

From this it will be seen that climatic conditions prevailing in the South are in no way unfavorable to the production of cheese. It may further be stated that the ordinary feeding stuffs of the South, particularly green sorghum and cotton-seed meal, exert a most favorable influence on the flavor of milk, and presumably upon that of cheese, though this has not been demonstrated. Since feeding stuffs can, in general, be produced more cheaply in the South than elsewhere, it would seem that there is room for the development of the cheese industry in that section.

Such an industry should of course be developed very gradually, because everyone connected with it, from the farmer who grows the crops that produce the milk to the operator of the cold-storage plant, who might very properly attend to the marketing of the product, will have much to learn. The situation is also somewhat complicated by the fact that the American people are not very fond of cheese. The history of agricultural industries in Europe, however, leads us to infer that the use of cheese in this country will increase in future much more rapidly than the population. The high price of meats in recent years should have an important influence on the consumption of cheese. Unfortunately, a great deal of the cheese made in this country has been of low quality, and has been put upon the market in an unripe condition; and Americans generally have a wrong idea concerning the place of cheese in the dietary. If our people could be taught to consume as much cheese as is consumed by corresponding populations in Europe it would, with our present population, require 17,000,000 good dairy cows giving milk nine months in the year to supply the demand for cheese alone. This is equal to the total number of dairy cows in the country at the present time. The improved methods recently introduced in the manufacture of cheese should have an important influence on the increase in the consumption of cheese in this country.

Of course, there will be many failures in attempting to establish cheese factories in localities in which dairying is a new industry. Unprincipled men will sell factory outfits at enormous profits to communities not ready to embark in the business. The labor of the South will have to be trained in dairy work; the stock of cows must be increased;

but it should be stated that the quality of dairy cows in the South is already quite satisfactory, compared with other sections of the country. After the home markets have been supplied, an outlet must be found for the surplus. But when all this has been done, as the writer believes it may be, the industry will do much toward increasing the prosperity of the southern farmer.

If anyone, as the result of reading this article, should contemplate embarking in the cheese industry in the South, he should do so with a full knowledge of the difficulties in the way. Yet, the experiment seems to be worth trying.

LIVE STOCK IN THE SOUTH.

There is at the present time room for a large development in the production of live stock in the Southern States. The production of feed for stock in the South is a simple matter. It is possible to produce at least two crops of forage a year on practically every acre of land now devoted to cotton. An increase in the production of live stock in the cotton districts would be of distinct advantage to the cotton interests on account of the favorable effect on the fertility of the land. Instances are not wanting where farmers who combine stock growing with cotton culture produce 2 bales of cotton per acre, while their neighbors who devote their land exclusively to cotton secure less than half a bale. The diversification of farming brought about by the increase in live-stock production would also bring better living to the farmer, and one of the most important advantages would be found in the distribution of the income of the farm throughout the year, thus enabling the farmer to live on a cash basis.

Hog raising is one of the types of live-stock farming most easily introduced, and the cotton-growing States are well adapted to this industry. There are some difficulties to overcome, and cotton growers would have much to learn before such an industry could be put upon a profitable basis, but it is certainly advisable for southern farmers to grow at least enough hog meat to meet local demands for this class of food. The general method which has been found most practicable for raising hogs in the South is to provide abundant green pasture, with shade and water adjacent, and to feed about one-third of a full grain ration to hogs on these pastures. Crops suitable for the production of hog pasture are alfalfa, rape, sorghum, peanuts, vetches, and the various cereals, such as oats, barley, rye, and wheat.

There is also opportunity for many farmers in the South to add materially to their income by raising a good quality of horses and mules for the market. There has never been a time in recent years when a good mule would not bring a good price in the South, and there is practically no part of that section in which there is not room for more or less development in business of this character.

That branch of live-stock farming which has superior attractions for most farmers seems to be the production of beef cattle. This calls

for less labor than most other types of live-stock farming, but it is also one which requires the most intelligent business methods for success. Very few men, even in the great live-stock region of the Middle West, are able to make large profits from the production of beef. While the industry has had comparatively little development in the South, the cheapness with which stock feed can be produced in that section would seem to indicate that there are possibilities in this direction. Two phases of beef production should be carefully distinguished, viz, that of growing the cattle and that of fattening them for the market. The South seems to be particularly adapted to the growing of beef cattle. That the highest quality of beef can be produced wholly in the South has been demonstrated, particularly by the work of the State experiment stations of Louisiana and Mississippi; but in fattening beef cattle it is improbable that the South will be able in the near future to compete with the States to the north with their cheap corn.

Perhaps the chief difficulty to be overcome in the development of the cattle industry in the South is that presented by the presence of the cattle tick, which transmits the disease commonly known as "Texas fever." Several of the southern experiment stations have worked out methods of eliminating the tick that are entirely practicable, and it is hoped that the recent movement for the diversification of agriculture in the South will give an impetus to the work already started in this line. The Mississippi experiment station has shown that under favorable conditions beef cattle can be grown in the South and sold to northern farmers for fattening purposes at a handsome profit.

SEED PRODUCTION.

One of the finest opportunities existing in the country to-day for the development of a paying business is that for the production of pedigreed seeds of ordinary farm crops. Much has already been done in this direction, particularly with the corn plant, and the Minnesota experiment station has demonstrated what can be done in the way of improved seed of wheat. There is a fine opportunity for intelligent farmers in the South in breeding varieties of cotton and corn. A variety of corn developed in one section of country may not be adapted to all sections of the region in which corn is grown; hence, there is an opportunity for breeding up improved varieties of corn in many different localities. Varieties adapted to southern conditions are particularly needed. To do this work successfully requires one who is familiar with modern methods of plant breeding. The opportunities in this line should be particularly inviting to graduates of the agricultural colleges who have had training in such work. Satisfactory methods of improving crops have been worked out in the Plant Breeding Laboratory of the Department of Agriculture and by the various State experiment stations. The demand for high-bred seed of all classes of farm crops is practically limitless.

PRESENT STATUS OF THE COTTON BOLL WEEVIL IN THE UNITED STATES.[a]

By W. D. HUNTER,
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MENACE OF THE BOLL WEEVIL.

The continued menace of the boll weevil to the cotton interests of the country was reflected forcibly at the National Cotton Convention, called to consider the problem at Shreveport, La., December 12 to 15, 1904. Two large State conventions to consider the same subject had previously been held in Texas, as well as a like number in Louisiana, but the full national bearing of the problem had never received such special attention up to that time. There is a possibility that the general feeling expressed by the many cotton experts present was somewhat more discouraging than the experience of Texas planters seems to justify. The work of the Department of Agriculture has demonstrated fully the practicability of producing a profitable crop in the present weevil-infested region, provided the planters receive what they consider a normal price for the staple. The prime difficulty is in inducing all planters to adopt the proper method, and there is another important obstacle in the fact that the present system does not apply equally well to all conditions. In view of these facts the recent statement (January 8) of the president of the New York Cotton Exchange, that "the fact that the boll weevil was responsible for a loss of perhaps 500,000 bales is fully admitted; the annual loss caused by the pest is too enormous to be overlooked," seems to be abundantly justified.

The ravages of the boll weevil have affected the cotton producers not only of Texas but also of the other cotton-producing States. They have disturbed the general economic conditions of the South, and likewise caused disturbances in every quarter of the globe where American cotton is used in the factories. The people in Lancashire, England, are almost as familiar with the work of the pest as are the people of the United States. Foreign governments have become alarmed. The Egyptian Government, for instance, on June 21, 1904, issued a formal proclamation prohibiting the importation of American cotton seed on

[a] Previous articles dealing with this topic have appeared in the Yearbooks of the Department of Agriculture for 1901 (pp. 369–380) and 1903 (pp. 205–214).

account of the danger of introducing the boll weevil. As a matter of fact, there is considerable danger that in time other cotton-producing countries may become infested by the weevil, and probably in many cases, owing to climatic and other conditions, suffer worse than this country has up to the present time.

Furthermore, the increased difficulty of producing the staple in the United States is having the effect of increasing the efforts of foreign governments to encourage the cultivation of cotton in their dependencies. The supremacy of the United States as a cotton-producing country is, in a large measure, due to the fact that climatic and soil conditions favor the production of a fiber of considerable length and strength, and consequently more in demand by the spinners than that produced in other quarters of the globe where there are large tracts of land suitable for cotton production. Owing to the necessity of procuring a very early crop in order to avoid damage by the boll weevil and to the present shortness of fiber of the varieties that have been found most useful, other countries might be able to produce an abundance of cotton, not necessarily of as good length as that normally produced in the United States, but nevertheless near enough to the quality of the staple which at present must be produced in weevil-infested regions to interfere decidedly with the supremacy of the United States in this industry. It is believed, however, that this is no more than a temporary difficulty. It seems well within the range of probabilities that the present efforts of the Department will result in improving the fibers of the useful varieties to a very considerable extent.

TERRITORY AFFECTED.

One of the most interesting features of the situation during the past season has been the fact that the infested region has extended eastward much more rapidly than northward. Careful examinations of Indian Territory, with special attention to the portions which the boll weevil is likely to reach first, have failed to reveal any traces of infestation. In fact, on the north the limitation of the infested territory remains practically the same as last year. This applies only to the total infested area in which even isolated colonies of the pest have been found to exist. There has been a gradual northward advance of the limits of what may be termed the region of "gross infestation;" that is, where the weevils are to be found in considerable numbers in all cotton fields. This advance has extended from the latitude of the northern portion of Ellis County to the latitude of the southern portions of Denton and Collin counties, a distance of about 36 miles.

This situation leads to speculation as to whether the pest has not reached a northern limit beyond which its spread will be prevented,

or at least checked, by climatic conditions. During the past year it has been found that there is at least one full generation less at Terrell, Tex., than at Victoria, Tex., 275 miles south of that place. In view of the very rapid multiplication of the pest this means a greatly lessened degree of actual damage. At least, the time when the number of weevils per acre reaches its maximum is considerably deferred, with a consequent manifest advantage to the crop. The lessened number of generations is due to three principal factors: (1) Later emergence from hibernating quarters; (2) greater time required for the development of the several stages; and, (3) the earlier date of the first killing frost. These would, theoretically at least, cause the weevil problem to be a much less serious one in the extreme northern part of Texas than has been the case in regions that have hitherto been infested, and the observations of the last season bear out this supposition. However, it is expected that there will be some adaptation on the part of the weevil to the climatic conditions in newly invaded regions, and this makes uncertain any prediction regarding future damage. Nevertheless, it may be said that in all probability the greatest damage done by the pest will always be in the region south of the latitude of Dallas, Tex.

To the east there has been a general extension of the infested territory of about 50 miles. The pest has been found east of the Red River at three points in Louisiana, namely, Lockwood, Grand Ecore, and Shreveport. In that State the greater portions of six parishes are known to be generally infested, while in three others the weevils are known to occur in certain restricted parts (fig. 9). Special opportunities for studying this extension were given by the cooperation of the Bureau of Entomology with the State of Louisiana in an investigation of the possibility of checking the pest. It was found that there was an advance early in the fall, due to the fact that the weevils were carried from place to place with seed for planting purposes; this was followed by a considerable extension of the territory infested, due to conveying the seed cotton to the gins; but, last and most important, there was an advance due to an actual migration, which reached in many cases far beyond the limits of the territory covered in the first two ways. The causes of this migration have received special attention. As a result of this work, complete information concerning the means whereby the pest reaches new regions—a part of the life history of the pest previously little understood—has been secured.

Altogether the additional territory infested during 1904 aggregates about 15,000 square miles, representing approximately an area devoted to the cultivation of cotton of 900,000 acres, the normal production from which would be in the neighborhood of 350,000 bales.

The total territory at present infested comprises about 32 per cent of the cotton acreage of the United States.

At frequent intervals during the past season (1904) the southern newspapers have contained accounts of the reported occurrence of the boll weevil at various points far beyond the limits of the infested territory shown upon the map (fig. 9). It seems likely that at any time the pest may be carried to points far outside of the present

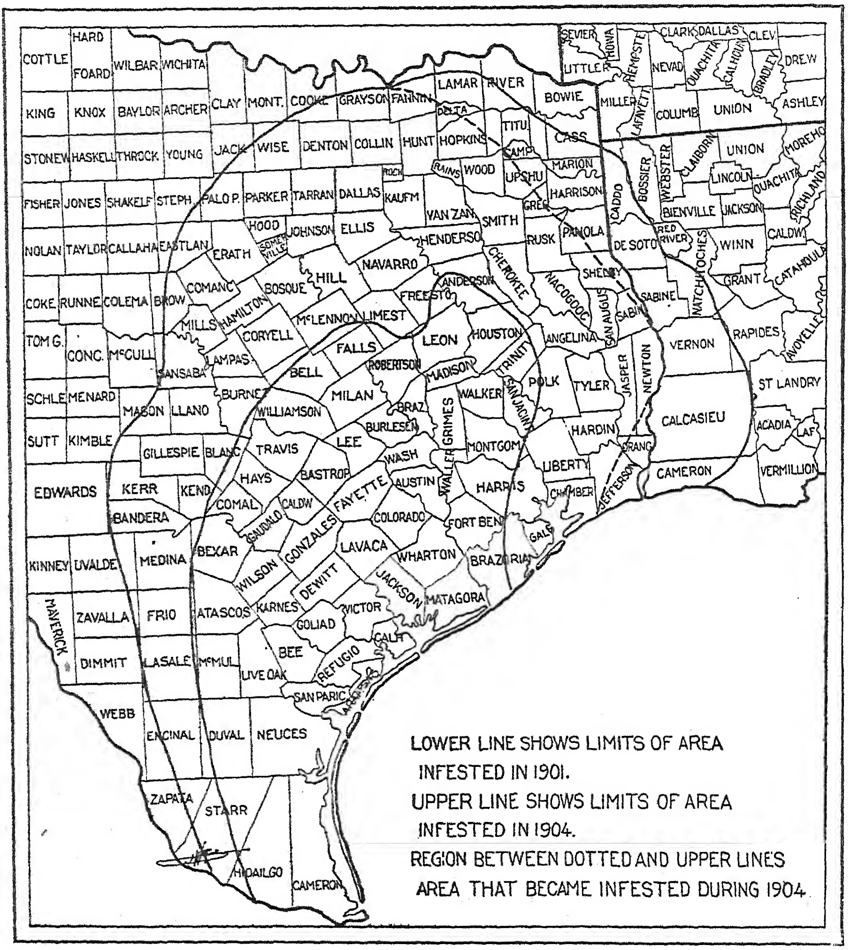

FIG. 9.—Territory infested by the cotton boll weevil (original).

infested territory through ordinary commercial shipments of cotton products. There is also some possibility that persons who have received live specimens from Texas for experimentation with supposed remedies may inadvertently introduce them into uninfested regions. These considerations have led the Bureau of Entomology to devote special attention to the reported occurrence of the weevil outside of

the region indicated. Entomologists connected with the Bureau have investigated a large number of reports coming from parts of Louisiana, Arkansas, and Indian Territory. Through cooperation with State and station entomologists, the Bureau has received specific information about reports originating in Georgia, South Carolina, and elsewhere. Fortunately it has been determined that all these reports have been based upon a misidentification of some of the rather numerous species of weevils which are sometimes found in cotton fields. Indeed, many other insects besides weevils have also been mistaken for the boll weevil, and some of the most persistent reports came from the confusion of the effects of the anthracnose disease of cotton with the supposed work of the boll weevil.

DAMAGE CAUSED BY THE BOLL WEEVIL.

As has been stated in a previous article on this subject,[a] it is naturally a difficult matter to express in figures the damage done by the boll weevil. In the paper referred to it was shown that, for a few years after the advent of the pest in a given locality, the production is reduced by about 50 per cent; but that, after such a period of great loss, many progressive farmers learn by proper methods to approximate their former yields. In some cases even, on smaller acreages, by practicing more intense farming the production is maintained. It is the unprogressive farmer, adhering to the old methods, who suffers the severest loss. On the whole, it seems within conservative bounds to estimate that, during the season of 1904, the weevil caused a shortage of at least 450,000 bales, representing a value (including that of seed) of about $22,000,000.

In view of the present very large crop,[b] the question has been asked why the weevil should be considered a great menace when such a large yield can be secured in spite of the fact that the weevils now infest about 32 per cent of the cotton acreage in the United States. The following appear to the writer to be the principal reasons for the present large production in Texas:

(1) It must be noted that in parts of the infested territory the insect has not yet become sufficiently numerous to appreciably reduce the crop. This observation applies to probably at least 10 per cent of the territory considered infested on account of the present isolated colonies. In many of the northern counties of Texas, for instance, the production could not have been reduced by the weevil, although the

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[a] Yearbook of the Department of Agriculture for 1903, p. 207.

[b] Estimated by the Bureau of Statistics of this Department on December 3, 1904, as 12,162,000 bales.

statistics show considerable variation from year to year, doubtless on account of changes in acreage and the ravages of other insects, like the bollworm. This is shown in the case of several counties in northern Texas in the table following. This table incidentally illustrates well the uncertainty involved in a comparison of the production in any list of counties in order to show the damage caused by the boll weevil. It is on such comparisons that many excessive estimates of damage have been based.

Cotton production in certain counties in northern Texas, in equivalents of 500-pound bales.

[From U. S. Census Bulletin No. 10.]

County.	1899.	1900.	1901.	1902.	1903.	Average.
Montague....	15,064	34,488	28,454	16,981	30,172	25,031
Bowie........	16,826	21,347	16,756	17,829	20,307	18,613
Red River	28,584	47,870	35,911	31,284	33,815	35,452
Collin........	49,077	70,963	60,049	47,344	62,979	58,082
Cooke........	11,905	18,751	19,561	11,012	20,813	16,408

(2) Throughout the portion of Texas where the bulk of the crop is produced, various conditions had conspired to cause an unusually small number of weevils to hibernate successfully. The principal factor in this situation was the very early date of the first killing frost in the fall of 1903, about thirty days prior to the average date. This destroyed a great many immature weevils in the squares and bolls that would otherwise have passed through the winter to damage the crop in the spring.

(3) A very important factor has also been a lessened damage done by the bollworm in the counties in Texas where the bulk of the crop is produced. Mr. A. L. Quaintance, of the Bureau of Entomology, who has conducted a special investigation of the bollworm during the past season, states that the damage done in 1904 can be estimated at a loss of about $2,500,000, as against an estimated loss for 1903 of fully $5,000,000.

(4) The high price at which cotton was selling just prior to the time of planting the crop of 1904 had the inevitable effect of increasing the acreage very materially.

(5) The growing season was very favorable. The average of the "condition" of the growing crop in Texas from May to September, inclusive, as published by the Bureau of Statistics of the Department, was 82 in 1904 as against 72.5 in 1903. The average condition for 1904, the season of the largest crop ever produced, was, in fact, much higher than that for 1900, when the average condition reported for the same months was 77.6.

(6) The picking season was abnormally favorable, resulting in an unusually small loss of the lint from rains.

(7) The large amount of work done by the Department and commercial bodies, which imported many carloads of improved seed, doubtless contributed to the increase of the crop.

A general idea of the effect of the ravages of the boll weevil in reducing the crop in Texas may be obtained from the following table:

Comparison of cotton production and acreage in Texas and Louisiana for 1899–1904.[a]

Year.	Texas.		Louisiana.	
	Acreage.	Crop.[b]	Acreage.	Crop.[b]
	Acres.	*Bales.*	*Acres.*	*Bales.*
1899	6,642,309	2,609,018	1,179,156	700,352
1900	7,041,000	3,438,386	1,285,000	705,767
1901	7,745,100	2,502,166	1,400,650	840,476
1902	8,006,546	2,498,013	1,662,567	882,073
1903	8,129,300	2,471,081	1,709,200	824,965
1904	8,704,000	3,030,433	1,940,000	893,193

[a] The figures for acreage have been taken from the reports of the Bureau of Statistics of this Department, also figures for production for 1904. The figures for production of previous years are from U. S. Census reports.

[b] The crop yield is given in bales of 500 pounds.

It will be seen that, while the acreage in Texas and Louisiana has been increasing at about the same rate, the crop in Texas has decreased annually for the past six years (with two exceptions, 1900 and 1904), while the crop in Louisiana has increased annually (with one inconsiderable exception, 1903). That the boll weevil is the cause which has prevented Texas from keeping pace with Louisiana will be admitted by all. The exceptional years, 1900 and 1904, in which the production in Texas did not decrease, were undoubtedly those in which the conditions for the cotton plant were unusually favorable. Moreover, it is to be noted that in the first of these two years the pest had not reached far into the most productive counties of Texas.

SCOPE OF THE DEPARTMENT'S INVESTIGATIONS.

The liberal appropriation made by Congress to enable the Secretary of Agriculture to meet the emergency caused by the ravages of the cotton boll weevil allowed a very considerable enlargement of the scope of the work during the season of 1904. The following lines of work were undertaken:

(1) Direct work on the cotton boll weevil.—This portion of the work was carried on under the direction of the Chief of the Bureau of Entomology, Dr. L. O. Howard, by the writer, as special agent in

charge in Texas. The headquarters for this portion of the work were located at Victoria, Tex., where a laboratory was maintained for two years. Thirteen experimental farms, aggregating about 1,500 acres, were located in the different parts of the State, where modifications of the present cultural system have been studied. The investigations of the life history of the insect, upon which any rational system of controlling it must be based, were continued. Parasites and the use of poisons were investigated fully. A special study in the field was made of the means whereby the weevil reaches new regions, and the direct bearing the matter had upon any attempt to check its further advance. The possibility of controlling the pest at the gins was investigated, an expert in cotton ginning being employed for the purpose. A system of certifying shipments of Texas farm products, which would otherwise have been excluded from shipment to various parts of the South on account of quarantine laws, was inaugurated. Nearly 1,000 car loads of various farm commodities were shipped under certificates issued by the Bureau of Entomology. The reports of the occurrence in Mexico of varieties of cotton which are immune to the boll weevil were investigated by an agent who twice visited that country. The extent to which birds may be relied upon as controllers of the boll weevil received particular attention. A large number of birds was shot in cotton fields, and their stomachs have been preserved and are now being examined.

Some of the results of this work have been incorporated in three Farmers' Bulletins (Nos. 189, 191, and 211) and one circular (No. 56, Bureau of Entomology) issued during the season.

(2) Demonstration work.—Under the direction of Dr. B. T. Galloway, Chief of the Bureau of Plant Industry, Dr. S. A. Knapp has organized demonstration work throughout the State of Texas, and to some extent in Louisiana. Doctor Knapp has started with the system of controlling the pest previously demonstrated on a smaller scale by the Bureau of Entomology, and has added to it numerous steps in the proper tillage of the soil and cultivation of the crop, which are of special importance in the present emergency.

(3) Diversification work.—Under the direction of the Chief of the Bureau of Plant Industry, and under the immediate control of Mr. W. J. Spillman, a number of farms were established to demonstrate the value of the diversification of crops.

(4) Work on the cotton bollworm.—This insect is, with the exception of the boll weevil, the most serious pest of the cotton plant in this country. Where both of the insects are present the problem is especially serious. Accordingly, an investigation of this insect

was undertaken, under the direction of the Chief of the Bureau of Entomology, by Mr. A. L. Quaintance. A laboratory was established at Paris, Tex., in the heart of the region where the bollworm does its greatest damage. A number of experimental farms were conducted in Texas, as well as in portions of Louisiana which are in immediate danger of invasion.

(5) Other cotton insects.—In cooperation with the Bureau of Entomology, Prof. E. D. Sanderson, of the Texas Agricultural and Mechanical College, made special studies of the numerous minor insects which affect the cotton plant.

(6) Cotton diseases.—Under the direction of the Chief of the Bureau of Plant Industry, Mr. C. L. Shear conducted experiments and demonstration work in different portions of the South, but with particular reference to Texas. This work in Texas dealt especially with the Ozonian disease known as "root rot."

(7) Plant breeding work.—Under the direction of the Chief of the Bureau of Plant Industry, Mr. H. J. Webber carried on important work in the breeding of early-maturing varieties of cotton, and in improving the qualities of fiber of some of the present known varieties which are rather poor in this respect.

PROBLEMS NOT YET SOLVED.

Although very satisfactory success has attended the efforts of the Department in combating the boll weevil, it must be stated that much yet remains to be learned. Persons who have observed the operations of the cultural system during a series of years in Texas have become convinced that it does not work equally well under all conditions. Moreover, at least with the usual facilities on the plantations of Texas, it must be confessed that the proper application of the cultural system increases the cost of production. The present low price of the staple is one of the most serious drawbacks with which this system has ever had to contend.

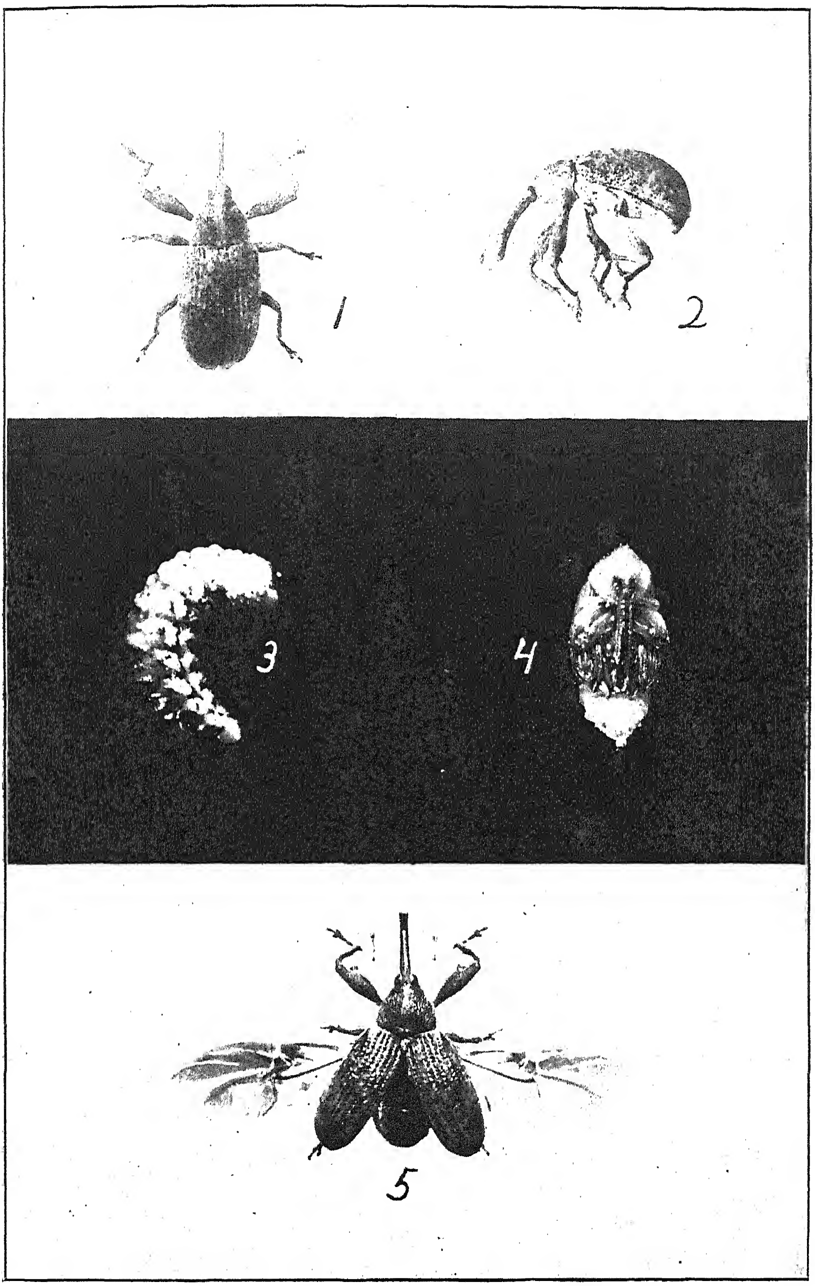
In some respects the term "cultural system" is misleading. It is frequently used simply in the sense of careful and persistent cultivation of the crop. However, the term as here employed applies to the various modifications in the cropping system which have been suggested by a study of the life history of the pest as useful in avoiding damage. Consequently the cultural system as here used is not merely a system of the proper cultivation of cotton, but a system of the cultivation best suited to mitigating the damage by the pest. Necessarily, it implies a thorough preparation of the soil and strict attention to all details of cultivation.

The most unfavorable aspect of the situation is that there may be many difficulties in the way of the application of the cultural system in regions that are about to be invaded, and which have climatic conditions quite different from those in Texas, where success has been obtained by that means. The destruction of the cotton plants in the fall is undoubtedly the most important factor in controlling the weevil. It attacks the insect at a time when the most good may be accomplished. It reduces by many millions the number of weevils that might go into hibernating quarters to emerge and damage the crop the succeeding year. Fall destruction may, of course, be practiced in Louisiana and other parts of the South. In addition to the obstacles in the way of this practice, namely, the hope for a top crop, the changing tenant system, and the scarcity of labor, there will, in other regions, be the additional difficulty that the cotton plant grows to a great size, and on alluvial lands matures late. The excessive size of the plants alone will interfere more or less with their destruction. More important, however, the general lateness of the crop produced on such plants will naturally throw the time for fall destruction so late that the practice may not be nearly as effective as in Texas. Moreover, the early-maturing varieties have the decided tendency, on rich alluvial lands with abundance of moisture, to lose their very essential character—that of earliness. King cotton, for instance, planted in the river valleys of Louisiana grows to a great height. Naturally such growth is at the expense of the very essential quality, as far as the boll weevil is concerned, of maturing the crop rapidly. There will be a similar difficulty in the proper spacing of the plants in order to bring about the destruction of many immature weevils in the squares on the ground. (See Pls. VII and VIII.)

To offset these expected difficulties it must be stated that the cotton growers in the portions of the South not yet invaded will have the very decided advantage of learning from the experience of planters in Texas. Nevertheless, as already pointed out, the experience of Texas planters largely concerns itself with the cultural system, in the application of which to other regions there may be considerable difficulties. These difficulties may be summarized as follows:

(1) Increased difficulty in applying the cultural system, due to rank growth, despite the use of phosphatic fertilizers and of early-maturing varieties of seed.

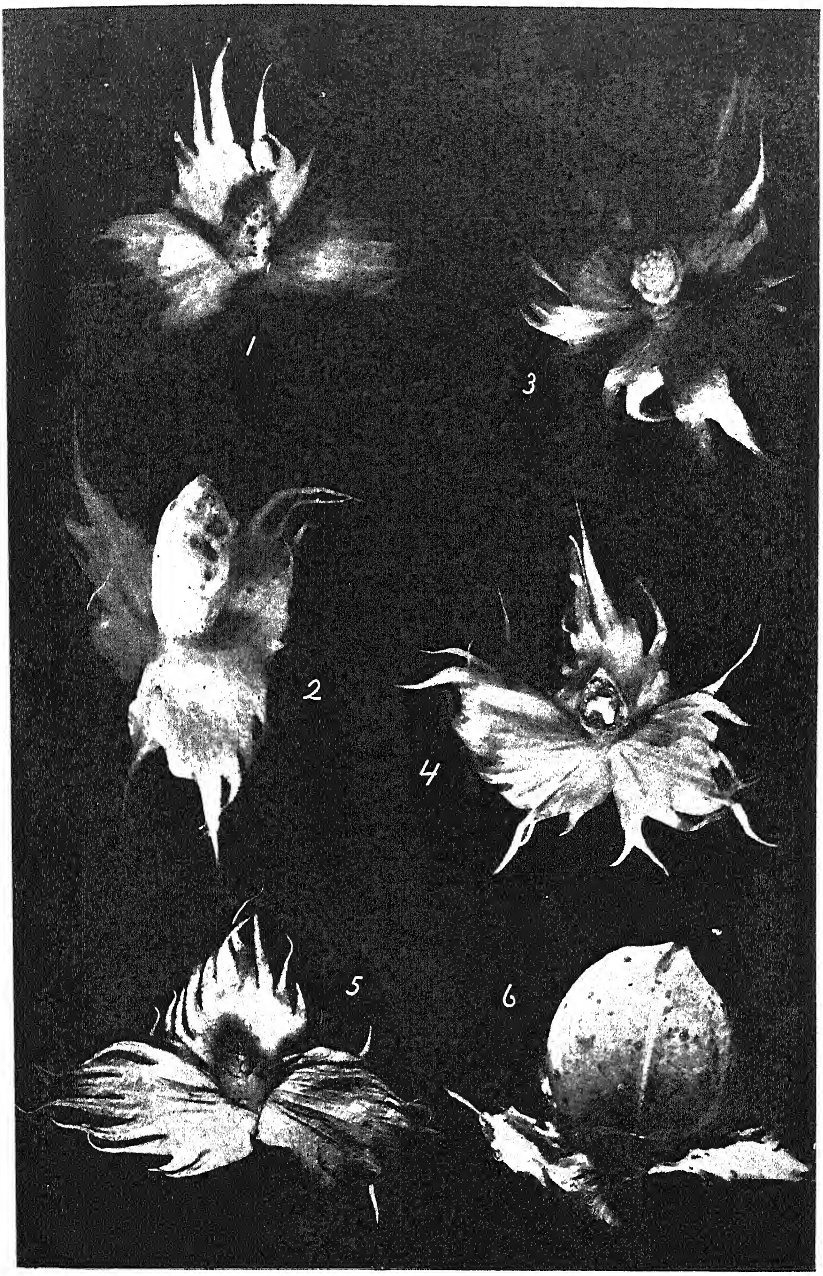
(2) The greater rainfall from the Sabine River eastward. Rank growth of cotton with an abundance of moisture are the two factors which contribute most to the rapid multiplication of the boll weevil. In Louisiana, during the growing months of May, June, July, and August, the average monthly precipitation for the past five years has been 4.47 inches. In Texas for the same term the average monthly



MEXICAN COTTON BOLL WEEVIL.

FIG. 1.—Weevil, back view. FIG. 2.—Weevil, side view. FIG. 3.—Fully grown larva. FIG. 4.—Pupa ready to transform. FIG. 5.—Adult weevil with wing covers raised and wings extended, ready to take flight.

[Four times natural size. Original.]



WORK OF THE MEXICAN COTTON BOLL WEEVIL.

FIG. 1.—Half-grown square destroyed by many feeding punctures by young weevils. FIG. 2.—Square ready to form bloom, very largely fed upon. FIG. 3.—Egg deposited at base of petal inside square. FIG. 4.—Large weevil larva being destroyed by smaller larva of Bracon mellitor. FIG. 5.—Weevil in act of escaping from fallen square. FIG. 6.—Large boll severely injured by many weevil punctures.

[Two-thirds natural size. Original.]

precipitation has been only 3.26 inches. The general scarcity of labor throughout the South, a difficulty which already presents a serious problem in Texas, will likewise prove a drawback in regions which will become invaded. To produce cotton profitably in weevil-infested regions requires additional labor at several times during and after the growing season. The present situation seems to indicate that the further advance of the insect must involve a decrease in acreage.

RELATION BETWEEN THE LEAFWORM OF COTTON AND THE BOLL WEEVIL.

Thirty-five years ago the ravages of the cotton leafworm (*Alabama argillacea*) attracted almost as much attention in some portions of the South as does the damage by the boll weevil now. Various changes in the system of cultivation of cotton in the South have combined to reduce the damage done by this pest, and, moreover, a very effective method of controlling it, by the use of Paris green, was discovered. It is one of the striking occurrences in the history of economic entomology that this formerly dreaded pest is now looked upon by the farmers in weevil-infested regions as decidedly beneficial. When the plants become defoliated by the worms the growth is checked, and consequently the opportunities for the breeding of the weevils in additional squares are reduced. This results in a marked decrease in the number of weevils at the end of the season. This decrease has not so much effect upon the crop of the current year as upon the following one, by reason of the lessened number of weevils going through hibernation. Moreover, when the plants have been deprived of most of their leaves the worms very frequently devour the squares and sometimes small bolls in which the immature stages of the boll weevil are located. In this way the worm acts directly as a remedial agency against the boll weevil. This work to some extent accomplishes the same object as the fall destruction of the plants, which, as is well known, is the greatest single factor in the successful production of cotton in weevil-infested regions. There is still another consideration in this connection, namely, that the defoliation of the plants allows the sun to strike the squares upon the ground, thus destroying many of the larvæ and pupæ of the weevil contained therein. At the present time, as the result of the conditions mentioned, the planters in Texas are rapidly giving up the practice of poisoning the formerly much-dreaded cotton caterpillar. If, as may occasionally happen, the plants become defoliated before the weevils reach the maximum numbers in the fields, the damage of the one insect will simply be added to the damage of the other. In that event the use of poison will be necessary.

ATTEMPTS TO PREVENT THE ADVANCE OF THE BOLL WEEVIL.

The crop pest commission of Louisiana, in cooperation with the Bureau of Entomology of this Department, has investigated fully the possibility of checking the pest by an attempt toward the eradication of the isolated colonies in connection with a rigid quarantine directed against farm products which might be considered as likely to convey the pest. During the season of 1903, a small colony of weevils was found in Audubon Park, in the vicinity of New Orleans. Energetic means taken at that time resulted in the complete extermination of the colony. Upon the basis of the successful outcome of this experiment and upon the further basis of what was then known concerning the means whereby the weevil reaches new regions, the crop pest commission started out early during the past season in an energetic attempt to prevent the further advance of the weevil in the State. The first step was to quarantine general farm commodities produced in infested portions of Texas in addition to the baggage and household goods of laborers in which there seemed some possibility that weevils might be transported. The next step in the campaign was an attempt to stamp out the few known isolated colonies in the western parishes of the State by causing the temporary abandonment of cotton culture. Accordingly, in Sabine Parish the commission perfected arrangements with the planters whereby for a certain consideration the latter agreed not to plant cotton during the season of 1904. The Bureau of Entomology was not connected with this matter in any other way than by assisting in it as a very important experiment. Four entomologists were detailed to assist the Louisiana commission in determining the presence of isolated colonies, and in studying generally the means whereby the pest is spread. The situation seemed very encouraging until about the first day of August. The weevil had not been found in the localities previously known to be infested, where the further cultivation of cotton was prevented. However, about the date mentioned there was a general and unexpected migration of weevils from west of the advance guard, where the experiment was being performed. This migration carried the weevils far over the localities where cotton growing had been stopped, and the failure of the attempt to check the weevil at once became evident.

It is considered that the knowledge of the weevil gained in this experiment is of very great importance. Certainly if it were possible to check the pest anywhere in the United States it would have been most feasible in the western portion of Louisiana, where the cotton fields are small and situated in isolated locations in the pine forests. Although the results have been negative, the complete demonstration

of the impossibility of checking the advance of the pest will doubtless prevent a great number of similar attempts that might otherwise be made from time to time in other States in possibly less favorable localities.

The present efforts to prevent the further spread of the boll weevil in the South are all in the form of laws, prohibiting the having in possession live weevils, and quarantining rigidly farm products that are supposed to be, or are likely to become, infested. Louisiana, Alabama, Mississippi, Georgia, South Carolina, and North Carolina all have laws along these lines. In general they are of such a nature as was recommended in Farmers' Bulletin No. 189 of this Department. In some cases, however, there is no doubt that the provisions are more drastic than is necessary. In several of the States shipments from infested territory of articles which can not be considered dangerous are prohibited. Nevertheless, the general salutary effect of the present laws is undoubtedly evident. As a matter of fact, it is certainly advisable for the States to be overcareful rather than to allow the shipment of articles that might possibly be the means of bringing in the weevil.

THE OUTLOOK.

For some time there has been no doubt that the boll weevil will eventually spread over all of the cotton-producing States, and careful observers agree in anticipating increased difficulties in combating it as new regions are invaded. A consideration of the problem, some of the more important features of which have been noted, shows clearly that the matter is still most serious. In fact, in Texas this is evidenced by the frequent very great interest in proposed remedies of all kinds, which, as in the case of Paris green during the past season, often results in the useless expenditure of large amounts of money. It must be confessed that such a general and persistent search for the specific, which large numbers of planters have believed successively to be mineral paint, poisoned cotton-seed meal, and Paris green, is an indication in some quarters of the lack of full confidence in the known means of mitigating the damage of the pest. It is gratifying to note that the extensive work of the past season has had the effect of reducing greatly any undue misapprehension regarding the cultural system, the result of the Department's work for several years.

There is now a strong tendency toward the passage and enforcement of State laws which will bring about concerted action in the most important steps in controlling the pest. The changes in farm practices made necessary by the weevil are so decided and the conservatism in some quarters so marked that legislation is undoubtedly needed. The proper steps are known and have been abundantly demonstrated. To obtain the best results there should be concerted action. In Louisiana

the law creating the crop pest commission now gives sufficient power to that body. In Texas, however, there is as yet no law on the subject.

The next great step to be accomplished in the boll-weevil fight is the passage in Texas of a law similar to that now in force in Louisiana delegating full authority to a board, the executive officer of which shall be an entomologist. Likewise, it seems that the best thing to be done by States that are in danger of invasion is to enact similar legislation which will provide machinery for the enforcement of such control as present knowledge of the subject permits, and that at the earliest opportunity.

THE RESPIRATION CALORIMETER.

By W. O. Atwater, *Chief*, and F. G. Benedict, *Physiological Chemist, Nutrition Investigations, Office of Experiment Stations.*

STUDIES OF THE DEMANDS OF THE HUMAN BODY.

In considering the demands of the body for nourishment and the purposes which foods serve in the body, it was natural that experimenters should direct their attention for a time largely to those questions which were most readily studied, such as the amounts of food eaten and their relation to growth, health, and other physical conditions. The chemical composition of different foods and the purpose served by different food constituents are closely related to such studies. The amount and character of the visible excretory products and the relation of the body outgo to the food eaten were questions whose importance was early recognized. Knowing the amount and composition of the food and the amount and composition of the solid outgo, it is possible to ascertain how thoroughly food is digested, and experiments to determine this point have been numerous and have given very valuable results. In tests of the adequacy of a diet and other problems equally important it is desirable to study also the amount and composition of the liquid outgo.

Besides the visible excreta, however, the body is constantly giving off invisible material in the breath. A knowledge of the kind and amount of these invisible products and their relation to food, to work performed, and to other factors, is a matter whose importance was early recognized and studied in various more or less satisfactory ways. Moreover, in addition to all the material products—visible and invisible—the body is all the time losing an immaterial invisible quantity, namely, the heat which is constantly radiated from its surface. We know that in order for heat to be given off from a stove or furnace a supply of fuel must be kept up, and it is obvious that something of the same nature must be true in the case of the human body. In the one case the fuel is coal, wood, or some similar substance; and in the other it is meat, vegetables, cereals, and other foods which make up the daily diet.

THE FURNACE AND THE HUMAN BODY.

Combustion in a furnace and combustion in the body are apparently very dissimilar; but, generally speaking, they are the same from a chemical standpoint. The former takes place rapidly, with the evolution of heat and usually of light; the latter more slowly and inconspicuously. If the food is likened to fuel and the body to a furnace, the respiratory products given off by the lungs correspond to the smoke and other combustion products which pass out through the flue. The solid and liquid excretory products of the body correspond in a way to the ashes of a furnace, which, of course, are made up of materials which could not burn completely and partly burned fragments that for some reason escaped combustion. One important difference between the human body and the furnace or steam engine is that the former is self-building, self-repairing, and self-regulating. Another is that the material of which the engine is built is very different from that which it uses for fuel; but in the case of the body part of the material which serves it for fuel also builds up and maintains the body tissue. Furthermore, if food is withheld the body can for some time use its own substance for fuel. This the engine can not do.

Obviously the body is more than a machine. It has not simply organs to build and keep in repair and supply with energy; it has a nervous organization, and it has sensibilities and higher intellectual faculties. It is, perhaps, not too much to say that the right exercise of all our faculties must ultimately depend upon the nourishment of the body which renders their existence possible.

In the case of an engine everyone recognizes the fact that one sort of coal may be more satisfactory and economical than another because it burns better and gives more heat per ton. It is equally true that one food may be more satisfactory than another because it is more thoroughly digested, more wholesome, or is a better source of energy. To determine the efficiency of an engine we need information regarding such factors as the energy or heat value of the fuel, the amount of ash and of waste products carried off through the flue, the quantity of fuel required for different kinds of work, the quantity of energy in the fuel which can be converted into useful work, and related questions. It is equally true that in the case of the body we need to know the most wholesome kinds of food, the relative amounts of waste material in different sorts, the amount and composition of the waste products and their relation to food and work performed, the amount of work possible on a given ration, and, in short, the best and most economical food for maintaining the body machine in perfect condition and enabling it to perform the necessary amount of physical and mental work.

APPARATUS FOR STUDYING PROBLEMS IN NUTRITION SECURED.

Bearing these various facts in mind, the need of some satisfactory laboratory apparatus for studying problems connected with the income and outgo of the body, the use which it makes of its food supply, the work which it performs, the value of different food combinations, and similar questions will be readily recognized. To meet such needs an apparatus has been devised in connection with the nutrition investigations of the Department of Agriculture. Since it permits of the measurement of the gases of respiration as well as the heat liberated from the body, it is called a respiration calorimeter. In the planning and carrying out of this work, which was begun in 1892 by Wesleyan University and the Storrs Experiment Station, the Department of Agriculture has cooperated since 1894.

In its general design the respiration calorimeter was inspired by the Pettenkofer apparatus, built about fifty years ago at Munich. Pettenkofer directed his attention chiefly to the measurement and analysis of the respiratory products, but in planning the respiration calorimeter used in the Department of Agriculture experiments the income and outgo of energy was taken into account as well, these factors being most conveniently measured as heat. After a considerable amount of experimenting the Atwater-Rosa respiration calorimeter was completed and has been used for a large number of experiments with satisfactory results.

In this instrument a current of air was pumped through the respiration chamber, and by ascertaining its composition and volume it was possible to learn the amount and character of the respiratory products given off by the subject in the apparatus, though it was not possible to measure directly the amount of oxygen used. This was felt to be necessary and the apparatus was accordingly modified by the introduction of new features, including devices for the direct measurement of oxygen, the expenses for these improvements being defrayed by the Carnegie Institution of Washington. This new form of respiration calorimeter is here briefly described.

DESCRIPTION OF THE RESPIRATION CALORIMETER.

GENERAL PLAN.

The apparatus consists of an air-tight copper box, surrounded by zinc and wooden walls with air spaces between, and is large enough for a man to remain in it in comfort for a number of days. A ventilating current of air is pumped through the chamber or box at such a rate that the subject can always be supplied with a sufficiency of pure air. The chamber contains a folding bed, chair, table, etc., and is provided with means for the introduction of food and drink and the removal of excreta. The ventilating current of air as it leaves the apparatus passes

through purifying vessels that remove the carbon dioxid and water vapor which make up the respiratory products given off by the lungs and skin. Fresh oxygen is then added to the air current to make up

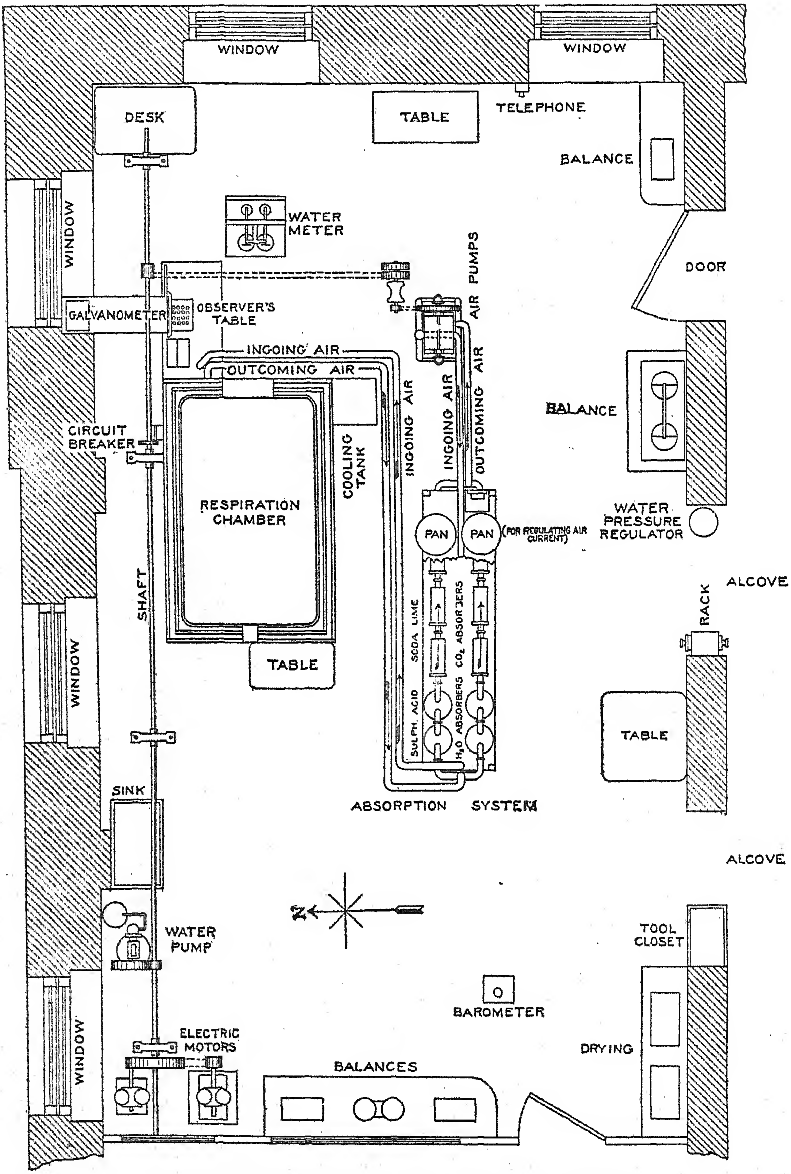


FIG 10.—General plan of respiration calorimeter laboratory.

for that withdrawn by the subject for the internal process of combustion in the body. When purified and laden with oxygen so that it is fit to be breathed the air current is again passed through the respiration chamber, this circulation of air being kept up as long as the

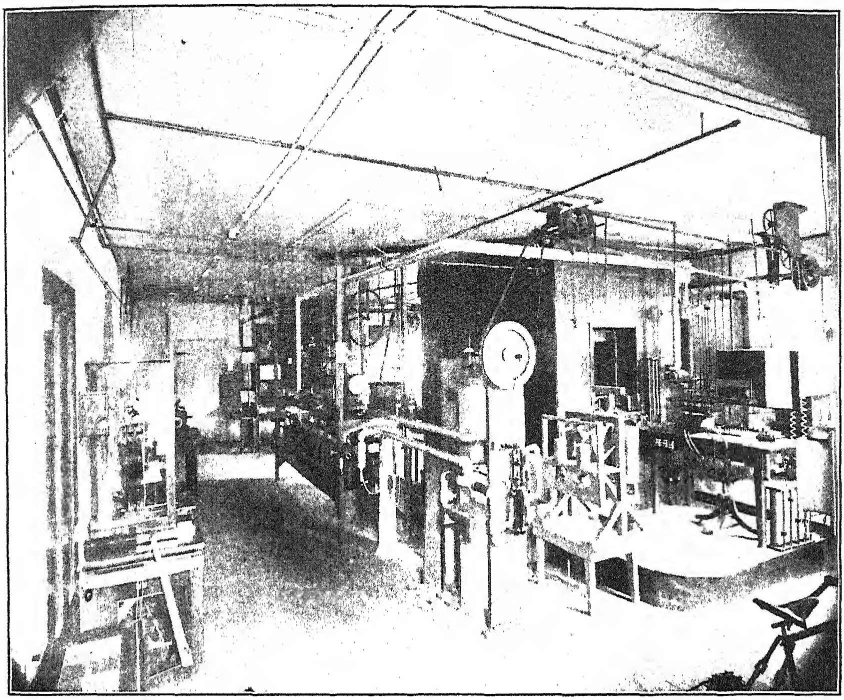


FIG. 1.—RESPIRATION CALORIMETER, GENERAL VIEW.

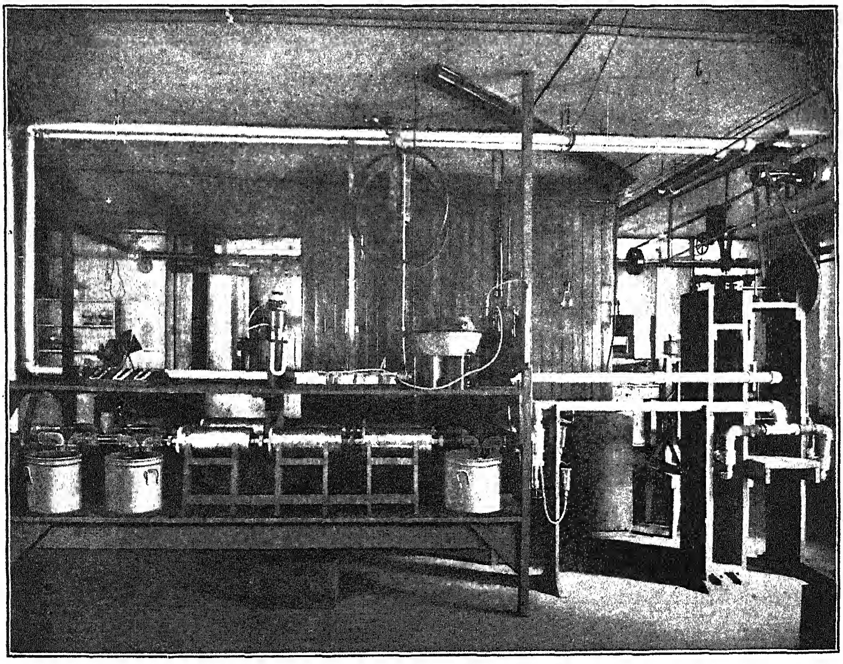


FIG. 2.—RESPIRATION CALORIMETER, SIDE VIEW.

experiment continues. The arrangement of the whole apparatus with its accessories is shown in figure 10. This gives a plan of the calorimeter laboratory, which is located in one of the rooms of the chemical department of Wesleyan University at Middletown, Conn.

On the north side is the respiration apparatus. Just south of this is the absorption system, through which the ventilating air current passes as it leaves the chamber charged with the respiratory products given off by the subject. The direction of the current is indicated by arrows. The air current as it leaves the chamber is first drawn through sulphuric acid, which absorbs the moisture in the air, and then through soda lime, which absorbs the carbon dioxid—that is, these two systems of absorbers free it from the products of respiration. After the oxygen is added the air passes back to the chamber pure and wholesome and ready to be breathed again. The circulation of the current is maintained by air pumps operated by electric power. On the east side is the observer's table, at which the assistant sits who attends to regulating the temperature within the apparatus and records the observations which are made during the progress of an experiment. A general view of the apparatus taken almost opposite the observer's table is given in Plate IX, figure 1. A side view, showing the purifying arrangements through which the ventilating current of air is passed, is shown in Plate IX, figure 2.

HEAT REGULATION AND MEASUREMENT.

A study of the heat given off by the human body on different diets, different conditions of work and rest, during sleeping and waking, and so on, is a very important matter in considering the functions and uses of food and the efficiency of the body as a machine. The energy value of food, coal, or other material can be readily learned by burning samples and measuring the amount of heat given off. The way in which the body uses the energy supplied by the food can be very conveniently studied with the respiration calorimeter. One of the most interesting features of this apparatus is found in the devices for measuring the heat given off from the body and regulating the temperature of the chamber so that the subject may be always comfortable.

Houses are very commonly warmed by a current of hot water which passes through radiators and gives off its heat into the rooms. If a current of cold liquid were circulated through the pipes it would absorb the heat and the room would be cooled, as is obvious when we remember that a similar plan is followed in cooling cold-storage chambers. In the respiration chamber a current of cold water passes through pipes which have a large surface, so that they may the more readily absorb the heat. As the water enters and again as it leaves, its temperature is noted. The amount of water passing through the pipes in a given time is also ascertained. Knowing the weight of water, the

rise in temperature, and the specific heat of the water, the amount of heat absorbed and carried out of the chamber by the water current may be readily calculated. The colder the water on entering the more readily will it absorb heat in its passage through the pipes, and, conversely, the warmer the water on entering the more slowly will it carry away the heat. Therefore, when the subject is working hard and giving off heat from his body rapidly the water current is cooled nearly to zero by passing it through cooling tanks before it enters the chamber; at the same time the rate of flow is increased. On the other hand, when the subject is at rest, especially during the hours of sleep, when muscular activity is reduced to a minimum, and the heat production of the body is at a low ebb, the water current is allowed to enter at a higher temperature and a slower rate. During the period of deep sleep the subject ordinarily gives off heat from the body at the rate of 60 to 75 calories[a] per hour, or enough to raise the temperature of 1.3 to 1.7 pounds of water from freezing to boiling. When he rises and sits quietly the hourly rate increases to 100 or 115 calories. When he works on a stationary bicycle, which is part of the equipment of the respiration chamber and used in work experiments, it reaches 300, 450, or even 600 calories per hour. Special devices are provided for taking account of these sudden changes in the rate of heat production.

The rapidity with which the heat given off by the subject is absorbed by the water current and brought out of the chamber is controlled by the observer, who sits at the observer's table outside of the apparatus. In practice the heat is brought away from the chamber just as rapidly as it is given off by the body, and consequently the temperature of the chamber is kept very constant. Delicate electrical thermometers indicate the temperature to one one-hundredth of a degree, and any slight temporary rise in the temperature of the chamber like that which would result from an increase in heat production because of movement of the subject, such as rising from his chair, stretching out the arms, or moving in bed, can be at once detected by the observer.

MEASUREMENT OF RESPIRATORY GASES.

In a study of the relative value of different foods for the body it is very important to know the amount and composition of the excretory products, including those given off through the lungs, in order that we may strike a balance between the income and outgo of the body and learn how much of the food material is retained and utilized. The visible excretory products may be readily weighed or measured and analyzed. In the case of the equally important invisible products the necessary measurements may be made with the aid of the respiration

[a] A calorie, as the heat-measuring unit is called, is an amount of heat which would raise the temperature of 1 pound of water 4° F.

calorimeter. The determinations include, among others, the collecting and weighing of all the water vapor and carbon dioxid given off by the body and the exact measurement of the oxygen used by it, oxygen being, it is hardly necessary to say, one of the principal constituents of the air and that portion of it which is essential for the oxidation of food materials in the body.

The ventilating air current pumped through the chamber brings out the water vapor and carbon dioxid. The outgoing air necessarily contains less oxygen than the incoming air, since some has been withdrawn for the uses of the body. The air current first passes through a vessel containing concentrated sulphuric acid or oil of vitriol, which completely deprives it of moisture. The dry air, containing the carbon dioxid and still deficient in oxygen, is then passed through a mixture of caustic soda and quicklime (so-called soda lime), which rapidly absorbs all the carbon dioxid. The arrangement of the water and carbon dioxid absorbers is shown diagrammatically in figure 10, and in their actual position in Plate IX, figure 2.

At the left side of the frame in which they stand are two sulphuric-acid cylinders, which take up the water; then follow three soda-lime cylinders for the absorption of carbon dioxid, and then another sulphuric-acid cylinder to retain any moisture which the air current may have taken up from the soda lime, which always contains a little water. Freed from both carbon dioxid and water, the air then passes on to the air pump at the right and is returned through the pipe along the top of the shelf, which may be seen in Plate IX, figure 2, above the absorbers. As it passes through this pipe measured amounts of oxygen are added to the air current from a cylinder of compressed oxygen, such as is used for many commercial purposes.

TESTS OF THE ACCURACY OF THE RESPIRATION CALORIMETER.

The purpose of the apparatus, as has been stated, is to measure accurately the oxygen used and the carbon dioxid, water, and heat given off by the subject during an experiment. It was necessary to subject the apparatus to rigid tests as to its adaptability for this purpose. The factors involved in the combustion or oxidation of food material in the body and the products evolved are the same as in the burning or oxidation of alcohol in a lamp, and the quantities of heat and combustion products, corresponding to a given weight of alcohol, are accurately known. It follows, therefore, that if known quantities of alcohol are so burned in the respiration chamber as to insure complete combustion, a comparison of the measured amounts of oxygen, water, carbon dioxid, and heat with the theoretical amounts will serve as a critical test of the accuracy of the apparatus and method.

Many such tests have been made with the respiration calorimeter, and on the whole the results obtained are very satisfactory, indicating that the measurements made with it are very accurate, and that the apparatus is suited for the physiological experiments referred to.

KIND OF EXPERIMENTS WHICH HAVE BEEN MADE.

The purpose of the experiments with the respiration calorimeter is to study the fundamental laws of normal nutrition, and so far all the experiments have been made with active men in good health—that is, with normal subjects. The majority of them have been laboratory assistants or students of mature years. The experiments have covered varying conditions of diet, work, rest, etc. The food which has been selected for the experimental diet has been carefully chosen, so that it might be suited in quantity and composition to the subject's needs and the purpose of the experiment, and the diet has been made palatable in order to insure normal results. In some of the experiments the subject, for purposes of comparison, has had a limited food supply or has fasted.

In the rest experiments a minimum amount of muscular exercise has been performed, the subject reading or writing a little to pass the time agreeably. In other experiments he has engaged in more or less active muscular or mental work. In connection with many studies of the body changes during muscular work a bicycle ergometer (shown in fig. 11) has been used, which permits of very accurate measurements of the external muscular work applied to the pedals. This instrument is placed inside the respiration chamber and is there ridden by the subject.

In appearance the ergometer resembles a bicycle with the front wheel removed, and the subject sits upon it and operates the pedals exactly as on a bicycle. In place of the rear wheel, however, there is a copper disk of about the same diameter as the wheel, the frame of the apparatus being raised enough to keep the disk from the floor. This disk revolves between the two poles of an electro-magnet. When there is no current passing through the magnet the disk may be turned very easily, and though turning it involves some muscular movement the quantity of work actually done is small. When an electric current is passed through the magnet it acts as a brake, and more effort is required to turn the disk, consequently more work is involved. The advantage of such a brake is that the amount of resistance actually applied can be measured. By varying the current passed through the magnet and the speed with which the disk is revolved, it is possible to control the amount of work performed, which may be measured. Experiments have shown that the apparatus gives very accurate results.

Some of the experiments with the respiration calorimeter have occupied only a few hours, but the majority have lasted from two to four

days and nights. Frequently several experiments follow one another, so that the subject passes ten or more consecutive days without leaving the respiration chamber.

The labor involved in conducting a complete experiment can be judged approximately when it is stated that the entire time of sixteen men is required to carry on an experiment properly. The food for the subject must be prepared and each portion weighed, the liquid and solid excreta must be measured or weighed, and suitable samples of both food and excreta prepared for analysis. The ventilating air current must be regulated, the oxygen supply controlled, and the amounts of carbon dioxid and water withdrawn by the absorbers deter-

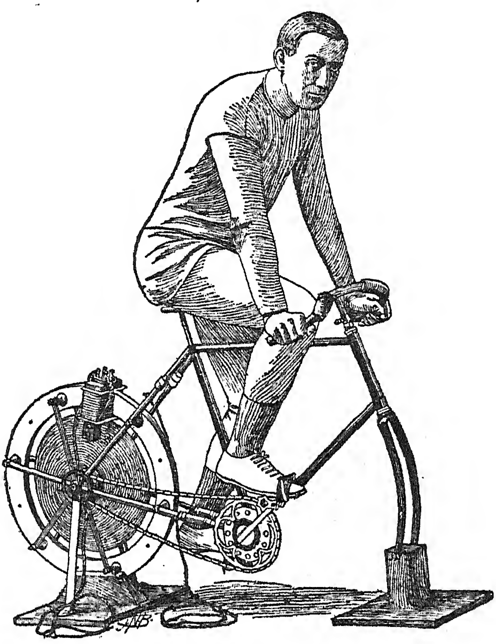


FIG. 11.—Bicycle ergometer.

mined by weighing from time to time. The temperature of the air inside the chamber must be kept constant, which necessitates hundreds of readings of the thermometers. The water current which removes the heat from the chamber must be controlled, and the amount of water passing through in a given time and its temperature on entering and leaving the chamber recorded at short intervals. The power which drives the air pumps and other machinery must be watched, and the whole complicated apparatus must be kept in perfect working order. All this necessitates thousands of weighings and measurements and the recording of a large mass of experimental data, as may be readily seen when it is remembered that some of the records are taken at intervals of two or three minutes, night and day.

After the experiment is completed numerous detailed analyses of food and excretory products must be made and the results of the experiment calculated, compiled, and tabulated. The experiment continues night and day, the day force being relieved by a corps of night assistants. The subject sleeps quietly within the chamber, and so regular is his life that a definite programme, which is drawn up in advance, is followed day by day.

At the time of writing 72 experiments with 9 different subjects, covering a period of 209 days, have been completed. In these experiments the total income and outgo of both matter and energy have been measured and studied. These experiments and the deductions from them are reported in detail from time to time in bulletins of the Office of Experiment Stations.[a] Some of the more important results may be spoken of here.

SOME RESULTS OF THE EXPERIMENTS.

AMOUNTS OF CARBON DIOXID AND HEAT GIVEN OFF BY THE BODY.

When coal is burned in a stove heat is generated and a gas known as carbon dioxid is given off, together with water vapor. In exactly the same way, but less rapidly, when food is burned in the body heat is generated and water vapor and carbon dioxid produced, the heat being constantly radiated from the body and the water vapor and carbon dioxid given off by the lungs and skin. The amount of heat given off by the body depends to a very large extent upon the amount of muscular activity, while the amount of water vapor and carbon dioxid eliminated depends upon both muscular activity and the kind of material which is burned in the body, whether it be protein, as the lean of meat; fat, like butter fat; or carbohydrates, such as starch or sugar; or a combination of these.

In the experiments which have been made with the respiration calorimeter all grades of muscular activity have been tested from deep sleep with a fasting subject to the excessive muscular work of a professional bicycle rider. When muscular work was performed other than that involved in the body motions essential to eating, drinking, and moving about in the respiration chamber, the muscular exercise consisted in operating the bicycle-like apparatus shown in figure 11. Light muscular exercise consists in running the wheel with no resistance. For moderately active muscular work a fair amount of resistance is applied by means of the electrical brake, and the rider turns the wheel at a definite number of revolutions per minute for a stated period. In severe work the resistance is kept the same and the number of revolutions increased or the resistance is increased and the

[a] Department of Agriculture, Office of Experiment Stations Bulletins Nos. 44, 63, 69, 109, 136.

revolutions kept the same. For very severe work either the resistance or the number of revolutions, or both, are still further increased. The results of the experiments, showing the output per hour of carbon dioxid and heat from the body under the different conditions indicated, are here summarized.

Average normal output of carbon dioxid and heat from the body.

Conditions of muscular activity.	Average quantities per hour.	
	Carbon dioxid.	Heat.
	Grams.	*Calories.*
Man at rest, sleeping	25	65
Man at rest, awake, sitting up	35	100
Man at light muscular exercise	55	170
Man at moderately active muscular exercise	100	290
Man at severe muscular exercise	150	450
Man at very severe muscular exercise	210	600

From the above table it may be seen that the output not only of heat but of carbon dioxid is very nearly proportional to the amount of muscular work. The average results quoted furnish data for estimating the amount of carbon dioxid and heat given off daily by men with varying degrees of muscular activity. For example, if a man sleeps 8 hours per day, we may say that the carbon dioxid output during this period is approximately eight times the hourly amount eliminated during sleep by the average subject, or 8 by 25 = 200. If he is at very severe muscular labor for 8 hours the carbon dioxid output would correspond to eight times the hourly amount for very severe work, that is, 8 by 210 = 1,680, and if the remaining 8 hours of the day were devoted to going to and from work, eating, sitting, etc., corresponding, say, to 6 hours of rest and two hours at light muscular exercise, the carbon dioxid output will be six times the average amount eliminated per hour at rest, that is, 6 by 35 = 210 grams, and two times the amount given off at light work, 2 by 55 =110 grams. The total for the 24 hours would obviously be the sum of the quantities mentioned above, or 2,200 grams. The heat eliminated in the 24 hours by men at very severe work may be likewise calculated by multiplying the time devoted to sleep, work, etc., by the average hourly output. In 8 hours at sleep he would eliminate 520 calories (8 by 65=520); in 8 hours at work, 4,800 calories (8 by 600=4,800); in 6 hours of rest, 600 calories (6 by 100=600), and in 2 hours at light exercise, 340 calories (2 by 170=340), making a total for the 24 hours of 6,260 calories.

For individuals at different occupations the chief variations in a calculation like the above would be concerned with the 8 hours devoted to work, as the conditions for the remainder of the 24 hours, that is, the time devoted to sleep, rest, and the light exercise involved in

going to and from work, etc., would be much the same in the majority of cases. Knowing the kind of work performed and the number of hours devoted to work and sleep, it will be seen that the calculation with reasonable accuracy of the total energy and carbon dioxid given off by the body is a very simple matter.

Thus, we see that, as a result of a large number of measurements made in the respiration calorimeter on a number of men, it is possible to obtain an important series of factors which, it may be stated, were not available until these experiments were carried out. These factors are of great value in estimating the needs of the body for food under varying conditions of exercise and muscular work, since, as has been previously stated, the energy output of the body is dependent upon the energy supplied in food.

VENTILATION.

In experiments with the respiration calorimeter the air which the subject breathes is analyzed with the greatest care, and it is obvious that since his physical condition is studied in relation to the character and amount of the air supplied the experiments may be made to furnish much data regarding problems of ventilation. In some of the experiments the rate of ventilation was much lower than has hitherto been considered possible.

Normal air contains about 3 parts of carbon dioxid per 10,000, and writers on ventilation have emphasized the importance of having the air in rooms changed so frequently that the amount of carbon dioxid will not become much greater than this. It was found that, in order to keep the air in the respiration chamber at so low a carbon-dioxid content, the rate of passage of the ventilating current must be so great that the pumps and analytical apparatus would be strained to their utmost capacity. In a long series of experiments it was found that the subject could get along apparently as well with a much lower rate of ventilation, that is, with much more carbon dioxid in the air, so that at present the ventilation is less than one-tenth of that usually advocated, and the carbon dioxid content is never less than 8 to 10 times the normal amount, and frequently for short periods it is as high as 50, 60, or even 80 times the normal proportion. It should be borne in mind, however, that the air is kept dry and otherwise pure, since the passage through the sulphuric acid of the absorber system would remove water and any unpleasant products which might be excreted, as in the breath.

The extent to which this high vitiation of air has been carried with no appreciable effect may be seen from an experiment made in the winter of 1904. If the atmosphere breathed by the subject contains abnormally high amounts of carbon dioxid, it is easy to conceive that the normal respiration might be interfered with. To test this

point the subject was made to wear over his face for 24 hours a light mask, connected with air pipes through which he was compelled to breathe. These pipes passed out through the chamber and carried away the products of respiration, so that the air in the chamber did not become vitiated. Under these conditions the subject breathed normal air for 24 hours, the amount of carbon dioxid produced and oxygen consumed being accurately recorded. During the next 24 hours the mask was removed and the subject breathed the air in the respiration chamber. The rate of ventilation was very much reduced and the amount of carbon dioxid in the atmosphere allowed to accumulate to such a degree that the subject was living in an atmosphere containing 226 parts of carbon dioxid per 10,000, or 2.3 per cent. This degree of vitiation is perhaps greater than men have ever lived in save in exceptional conditions when they have lost consciousness in closed chambers, as in caissons, submarine boats, etc. It would have been impossible to light a match or burn a candle in the respiration chamber during the experiment, yet the subject, who was purposely not told anything regarding the degree of vitiation, was indifferent to the atmospheric conditions. He read, slept, communicated with the observers through the telephone, ate his meals with the usual regularity, and, indeed, was so pleased to be relieved from the necessity of wearing the mask, as on the day before, that he was in excellent spirits.

It would be natural to suppose that with so great vitiation of the air the subject would feel languid, mentally inefficient, and would possibly lack appetite, yet none of these effects was noticeable. It appears that on the day in which the subject wore the mask and breathed pure air, and on that in which he breathed the air with a high carbon-dioxid content but without knowing that this was the case, the amounts of heat evolved, carbon dioxid produced, and oxygen consumed were practically the same. In other words, as shown by experimental measurements and his physical and mental condition, it was immaterial to this subject whether he lived in an atmosphere containing a normal amount of carbon dioxid or whether he was breathing air containing almost eighty times the normal quantity.

It should not for a moment be inferred, however, that such an experiment is a logical argument for poorer rather than better ventilation, for of the several factors concerned in insufficient ventilation only one, the carbon-dioxid content, was here studied. Ventilation problems must also take into account the diminished oxygen content, excessive moisture, excessive heat, and related conditions.

It must be borne in mind that during the experiments recorded the water content of the air and the temperature of the chamber were both regulated with great accuracy and were approximately normal. That we need as large an amount as possible of pure fresh air of even

temperature is no longer questioned by anyone, but that the amount of carbon dioxid is in itself as important a factor in the vitiation of air as has been commonly supposed can hardly be believed in view of these experiments. The whole subject is one which should receive further attention, and it seems only fair to say that the respiration calorimeter offers a method of experimenting which promises more in the way of useful results than those which have been hitherto followed.

BODY TEMPERATURE.

One of the interesting problems which have been studied in connection with the respiration calorimeter experiments is that of body temperature, its normal fluctuations, the extent to which it is influenced by external conditions, and related questions. Our bodies are continually generating heat by the internal oxidation of food and simultaneously giving off heat by radiation, etc. Obviously, if the heat elimination is so regulated that the amount lost in a given time is the same as that generated there will be no change in body temperature, and that such a regulation exists is shown in the fact that as long as the body remains in health it has a temperature not far from 98° F.; indeed, this temperature is commonly marked on thermometers as blood heat. If, however, there is a disturbance in the body mechanism a rise in temperature is commonly noted. When this is at all marked we designate it fever. Doubtless few persons realize that normally the body temperature undergoes a daily variation of not far from 2° F. Between 2 and 4 a. m. the body temperature is at its lowest point, and generally about 4 to 6 p. m. it is at its highest point. With the ordinary clinical or fever thermometer of the physician one would not be apt to recognize clearly this variation in normal body temperature, but with the delicate electrical thermometers used in connection with the respiration calorimeter experiments it is possible to demonstrate it and, indeed, to study very minute variations in body temperature with great accuracy.

A physician usually takes the temperature of a patient by having the thermometer held in the mouth under the tongue until it has assumed body temperature. In the experiments referred to it has been found much more advantageous to take it in the intestine, inserting the thermometer in the rectum. The thermometer used is very flexible. It is constructed of copper wire coiled in a silver tube, the wires leading to the instrument where the temperature is measured being covered with soft rubber tubing. The thermometer can be worn day and night without discomfort. When worn by a subject inside the respiration chamber the changes in temperature are indicated by means of a galvanometer, and are recorded by the observer outside, together with the other experimental data. The subject is

undisturbed by the experiments which are being made, goes about his usual daily routine, and at night sleeps undisturbed, although his body temperature is being measured to the hundredth of a degree every four minutes. As the result of a large number of experiments, it has been found that the body temperature falls off rapidly on going to bed and continues to fall slowly until a minimum is reached early in the morning. There is a rapid rise in temperature between 6 and 8 a. m., followed by a slower rise during the day, the maximum being reached between 4 and 6 p. m. In the evening the temperature again falls gradually until the time of retiring, when, as stated above, it drops rapidly. This is, of course, the average temperature fluctuation. It is surprising to note that in the majority of cases studied individual variations from the normal are very slight.

Many of the results regarding body temperature which have thus far been obtained serve only to verify the work of earlier investigators. Nevertheless, as a whole, it is believed that they contribute a by no means unimportant chapter to our knowledge of temperature fluctuations, especially during sleep, a period which at best could be but poorly studied by the ordinary methods of thermometry.

A knowledge of normal variations in body temperature and the effect of various factors on it can not fail to be of use to physicians, especially in cases where treatment is based to a considerable degree on the indications given by temperature charts. The experimental methods indicated above furnish a convenient way of studying the whole question of body temperature, its cause and determining factors, its relation to external temperature, work and rest, and other factors. The subject is one which is closely related to that of the effect of hot and cold climates on the body and its food requirements and power to produce useful work. In the respiration chamber it is possible to maintain at will high or low temperature and humid or dry air, and by its aid many problems like those indicated can be studied.

All know that there are marked differences in our feelings of physical comfort dependent upon the materials of which our clothing is made, that is, the amount and kind of protection from heat or cold which it affords the body. This is in part due to the character of the articles worn, that is, whether they are linen, wool, cotton, or silk, and is in part due to the fineness of weaving, the closeness with which the clothing fits the body, and the general character of the textiles selected. Certain fabrics hinder the radiation of heat from the body, and so keep it warmer than others. In the same way we associate coolness with certain materials and colors. The completeness with which water vapor, that is, perspiration, is absorbed by clothing or allowed to pass away from the body surface is also a factor of great importance in judging of the relative merits of different fabrics. The relative value of various textiles for hindering radiation—keeping

the body warm—and of others for helping radiation—keeping the body cool—may be readily studied with the respiration calorimeter, as may numerous other problems connected with the hygiene and comfort of dress.

CONCLUSION.

In the preceding pages the respiration calorimeter has been briefly described, the methods of operating it have been discussed, and some of the results which have been obtained with it briefly spoken of. Many other important problems have been investigated, and a large amount of experimental data has accumulated. All the questions studied have to do with the fundamental laws of nutrition, and, in brief, it may be said that it is in seeking knowledge regarding these laws that the respiration calorimeter finds its greatest use. With this and the accessory apparatus, combined with the chemical and physical methods of analysis common to all well-equipped laboratories, the complete intake of food, drink, and air, expressed in terms of chemical elements and energy, and the complete output of energy and gases, solid and liquid excreta, and heat may be ascertained. By comparing one with the other we can determine whether the body has gained or lost material or produced more energy than it has received. Continuing experiments through comparatively long periods and under a very great variety of conditions, we are enabled to measure the effects of food and fasting, rest, sleep, muscular and mental activity, and other conditions upon the food requirements, the amount and character of the excretory products, the changes which the matter and energy supplied by the food undergo in the body, and the effect of external conditions and body changes upon the comfort and well-being of the subject.

When we remember that numerous problems relating to hygiene, ventilation, climate, and related questions can also be studied, it is obvious that the investigator has a wide field for his efforts.

NEW CITRUS CREATIONS OF THE DEPARTMENT OF AGRICULTURE.

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Introduction.

For a period of five years, from November, 1892, to October, 1897, the writers were associated in the study of diseases of citrus fruits in Florida, being located at Eustis, in the central part of the State. A careful study was made of the varieties cultivated and of the industry in general, primarily as a basis for an intelligent investigation of the diseases and methods of their control. In the course of these studies the attention of the writers was early drawn to the desirability of breeding more varied and improved sorts.

An examination of the manner of origin of the various native sorts shows that in almost all cases they originated as accidental seedlings. Some growers made hybrids and used systematic methods of breeding, but the number of fruits which have originated in this way are very few indeed. The long time required to bring seedlings to bearing, the cost of cultivation and manuring, and the uncertainty of results have deterred growers from experimenting very extensively in this field. Owing to these difficulties, it seemed from the nature of the case that the investigations should be undertaken by the National Department of Agriculture, in order that the necessary funds could be provided and that the work could be carried on continuously for a series of years. This course was approved, and, under instructions from the Secretary of Agriculture, the writers, under assignment of Dr. B. T. Galloway, now Chief of the Bureau of Plant Industry, in the winter of 1892–93 made a careful study of the various citrus varieties and began the work of hybridization as rapidly as the time at their disposal would permit. These first attempts were largely preliminary, and most of the seedlings obtained were lost in the great freeze of 1894–95, which killed to the ground all orange trees in the northern and central parts of Florida. This seriously interrupted the work and compelled its temporary abandonment, owing to the fact that no groves could be found in the State furnishing the conditions necessary for carrying on hybridization. The experiments were taken

up again in the winter of 1896–97, when the writers made an extensive series of crosses at Eustis and Braidentown, being assisted in the work by Mr. Otis H. Gates. Again, in the springs of 1898 and 1899, one of the writers made further crosses which resulted in greatly increasing the number of hybrids. There have now been produced a total of 1,780 hybrids, and these are being grown and tested under general instructions from Mr. A. F. Woods, Pathologist and Physiologist of the Bureau of Plant Industry.

In all of the operations of hybridization the greatest care was taken to avoid contamination with pollen from other sources. In all cases buds were selected for hybridizing before they had opened and given opportunity for cross-pollination. These were opened and emasculated, after which they were covered with paper bags to prevent the access of insects bringing in pollen. When the emasculated bud had matured sufficiently to be receptive, the bag was removed and pollen of the variety selected as the male parent was dusted over the pistil. The bag was then replaced over the flower and left until fecundation had taken place, after which it was removed and the flower labeled. The flowers which were used for supplying pollen were also covered with paper bags previous to their opening, to prevent insects from leaving other pollen on them, which might be transferred in the operation of hybridization.

In much of the hybridization and breeding work which has been carried on by different investigators little attention has been given to the choice of the varieties used as parents and to the objects sought in the experiments. The time of this haphazard work, however, is past, as experience has demonstrated that it is far better for the experimenter to have a definite object in view and to select, as parents for hybridization, varieties which possess the characters that it is desired to combine in the hybrid. In the present experiments the following were the primary objects sought: (1) Hardier varieties which would endure the occasional severe freezes which visit the orange sections, and, if possible, varieties sufficiently hardy to be grown farther north than the present citrus belt; (2) new fruits having the loose, easily removable rind of the mandarin and tangerine combined with the quality, flavor, and size of the ordinary sweet orange; (3) new fruits having the sprightly acid flavor of the pomelo with the bitterness reduced, and the loose, easily separable rind of the mandarin and tangerine; and, (4) new fruits intermediate between the pomelo and the orange which would possess desirable market qualities.

In all of the writers' experiments these primary objects have been kept clearly in view, and varieties have been selected for hybridization which by their combination would be likely to give hybrids having the characters desired. As the hybrid fruits matured they were sent to Washington, where the seeds were extracted and germinated in a

greenhouse. When the young seedlings had reached a size of from 12 to 18 inches in height they were sent to the Department's Subtropical Garden at Miami, Fla., where they have since been grown under the supervision of Prof. P. H. Rolfs. When the seedlings were sent south the tops were cut back and the twigs used to furnish budwood for budding proper stocks to obtain trees for trial. These trees were tested in cooperation with different growers, arrangements being made with a number of intelligent, trustworthy growers to bud from one to two stocks with each of these hybrids and grow them until sufficient fruits had been produced to show their character and value. In the case of the hybrids made with the idea of securing hardiness, trees were budded and grown under the direct supervision of the Department by Mr. G. L. Taber, at Glen St. Mary, in northern Florida. Owing to the conditions under which the various trees have been grown very few of them have yet fruited. Several freezes have visited Florida in the last five years, and in many instances all of the hybrid buds sent to growers have been killed. In but few instances have large stocks been used which would force the buds into early bearing; nevertheless, several very promising new types have been produced, and without doubt many more fruits of value will be obtained when all of the hybrids have been brought into bearing. It should be noted that in fruit trees of this sort all of the varieties are *clons*, that is, varieties which are propagated by buds, grafts, or cuttings. A hybrid of value, when once secured, can thus be propagated indefinitely by budding or grafting, without awaiting fixation, as is necessary in the case of plants propagated by seed, where a desirable hybrid must be selected through a number of generations and bred to a fixed type that will come true through the seed before it can be utilized.

Production of Hardy Citrus Fruits.

The citrus industry in Florida has frequently suffered from severe freezes. The most disastrous of these probably were the freezes of 1835, 1886, and 1894–95, which killed or seriously injured almost every tree in the State. Other minor freezes have occurred from time to time, which, while not so severe, have seriously damaged many orange groves. In California and Arizona, also, citrus trees are frequently injured by severe cold. It is thus clear that the most desirable improvement in the orange and other citrus fruits is the securing of varieties which can endure lower degrees of temperature and which may be grown throughout the present orange-producing sections without danger of injury by cold.

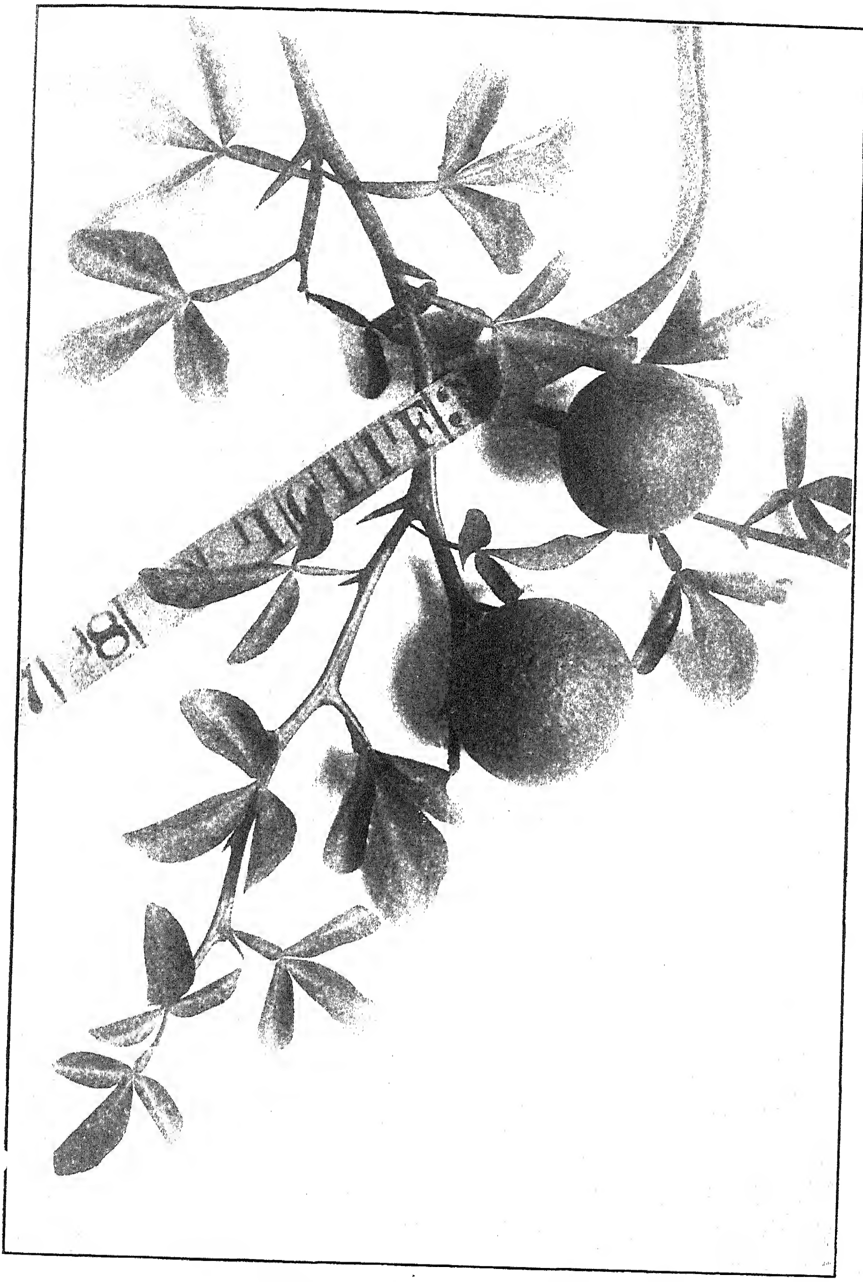
In attempting to improve citrus fruits in hardiness, two methods present themselves. One method would be to grow a large number of seedlings and select from them the individuals which possess the

greatest degree of hardiness, and continue this selection throughout numerous generations in the hope of augmenting any greater degree of hardiness that might be discovered. To pursue this policy with citrus fruits would require so long a period to secure any marked results that the method is impracticable. This is shown by the fact that for many years citrus growers have been making selections based on the hardiness of seedlings, and as yet no appreciable advance has been made in this direction.

A second method would be to select some hardy wild or cultivated type and cross this with the sweet orange or lemon in the hope of obtaining good varieties, combining the hardiness of one with the good fruit quality of the other. If such a hardy type exists, this method would certainly seem to be the quickest and most practicable way of securing hardy varieties. A species of citrus known as the trifoliate orange (*Citrus trifoliata*) is such a hardy type, which can be grown without protection as far north as Philadelphia. The common variety of the trifoliate orange (Pl. X) was introduced into this country by the late William Saunders, of the Department of Agriculture, in 1869. The tree is small and bushy and very spiny, and the leaves are trifoliolate and deciduous. It is quite commonly grown as a lawn tree in the North and as a hedge plant in the South, while in the colder sections of Florida it is used as a hardy stock on which to bud the common orange and other citrus fruits. The fruit (Pl. XII, fig. 4, and Pl. XIII, fig. 2) is round and small, ranging from 1¼ to 2 inches in diameter, and is orange-colored. The surface is covered with minute fuzzy hairs and is in most cases smooth, being rough only in the larger and more vigorous specimens. The rind, which adheres tightly, is about one-sixteenth inch in thickness. The pulp is acrid, bitter, and gummy, and the enormous number of seeds leave little room for pulp. The fruit is thus worthless as far as edible qualities are concerned. It is highly aromatic and attractive in appearance, making the plant desirable for ornamental purposes. Unfortunately, however, for its use in the South, the tree is deciduous, losing its leaves in the fall, and in general throughout this section an evergreen hedge is most desired. Notwithstanding this, it is generally cultivated as a hedge plant because of other qualities which make it desirable for this purpose. Its hardy character, however, is the factor of importance in connection with the experiments in the production of a hardy orange.

A second variety of the trifoliate orange, having rather larger leaves and very large flowers, has been found growing in several places in Washington, D. C., but has not been used in the present experiments.

The first variety described, the ordinary trifoliate orange, was the one used in the work of the writers, though the second might be more promising to use with the lemon, and some of these crosses have been



BRANCH OF TRIFOLIATE ORANGE.

[About one-half natural size.]

made. However, no fruits have thus far been obtained. All varieties of the trifoliate group are deciduous, and ripen their fruit early in the fall before frost. They are also late in blooming in the spring, the flowers, which appear before the foliage, not even showing until the common sweet orange is nearly through blooming. The trifoliate is thus about two to three weeks later to start growth in the spring, and is never caught by late frosts. The early ripening of the fruit in the fall, moreover, allows the tree to become dormant at a time much earlier than the common sweet orange, which is evergreen and inclined to grow more or less through the winter during warm periods.

It is a well-known principle in plant breeding that in hybridization the characters of races and species break up and become combined in different ways in the hybrids. It would thus seem entirely probable that by crossing and recrossing the common orange with the hardy trifoliate orange a hybrid could ultimately be obtained combining the desirable fruit characters of the former with the hardiness of the latter. Many instances are recorded where hybrids have been obtained combining certain characters of the parents, and a few cases are known of hybrids which are intermediate in character of hardiness between the parents, being more tender than one parent and much hardier than the other. The improbability of obtaining the hardy quality in an orange variety is thus not so great as one might be inclined to think. If, by infusing the blood of the trifoliate orange into the sweet orange, we can modify the season of growth of the latter and cause it to remain more dormant during the winter and later into the spring, our object would be accomplished. If, on the other hand, a hybrid can be secured having an entire segregation of the characters and combining the hardiness of the trifoliate with the superior fruit qualities of the sweet orange, a far greater success would be achieved.

The sweet orange and the trifoliate orange are very distinct in character, and it has been found in the course of the experiments that they are very difficult to hybridize. Even by using the utmost care in the process of hybridization only about 2 per cent of the flowers operated upon set fruit. The process of crossing flowers of the trifoliate orange with pollen of the ordinary orange is much more difficult than the opposite cross where the orange is used as the female, as the flowers of the trifoliate orange are quite small at the time of emasculation, are attached very lightly, and are easily broken off or injured. It would thus seem that the lack of success in getting fruits to set was caused partially by the injury to the flower in the process of emasculation. This, however, is certainly not the only reason for the small percentage of fruits that set, as there is also a great loss when the reciprocal cross is made; that is, when the common orange is used as the mother parent. The seeds resulting from these crosses were also poor in germinative

power, not more than half of the seeds obtained finally producing seedlings. In the course of the experiments, however, a number of hybrids were secured where both the common orange and the trifoliate were used as the seed-bearing parent. Some of these hybrids plainly show the characteristics of both parents and are doubtless true hybrids. Out of 40 hybrids of the trifoliate orange crossed with the pollen of the sweet orange, 29 resembled the former in habit and foliage characters, so far as could be observed, while 11 were clearly intermediate in these characters. These 11 intermediate plants are very similar to each other, deriving certain characters from each parent. The leaves are trifoliolate in form and are much larger in general than those of the normal trifoliate orange. The central leaflet has a tendency to be much larger, but the lateral leaflets remain about the size of those in the trifoliate orange, and in some of the seedlings these lateral leaflets tend to become abortive, thus approximating the unifoliolate sweet orange.

FIG. 12.—Three seedlings grown from a single seed of a hybrid (tangerine crossed with trifoliate); seedling with trifoliolate leaves (on the right) is a true hybrid; the other two seedlings with tangerine-like leaves are false hybrids.

During these experiments it has been found that some complexity is liable to arise, owing to the polyembryonic nature of citrus fruits. It is well known that seeds of various citrus fruits frequently produce more than one seedling. Instances have been noted where a single seed has produced as many as 13 seedlings. In cases where strikingly distinct types of citrus fruits were crossed, the interesting observation was made that where two or three seedlings were developed from a single seed they not infrequently showed marked foliage differences (fig. 12). Strasburger, in his critical study of the polyembryony of this group, found that the embryos, other than those developed from the fecundated egg cell, are derived from certain cells of the nucellus, lying near the embryo sac wall, which become specialized, grow, and develop rapidly, and form a tissue mass, which pushes out into the embryo sac and forms an embryo similar to that formed in the normal way from the egg cell. The embryos formed in this way Strasburger called "adventive." If we correctly understand the action of fecundation, it is clear that in this group only those embryos that develop from the egg cell proper as a result of the fecundation would show an indication of hybridization. Since the adventive embryos develop directly from the mother tissue, in these we should not expect to see any of the characters of the male parent. This conclusion was reached by

the writers early in the experiments, before the growing of the seedlings had shown definitely what would take place, and the development of the hybrids has proved this conclusion to be well founded. In several hybrids of the sweet orange, which is unifoliolate, with the trifoliate orange, which has trifoliolate leaves, where the former was used as the female parent, two and three seedlings have been produced from the same seed, one of which had trifoliolate leaves, showing clearly the influence of the male parent, while the other or others had strictly unifoliolate leaves exactly like the mother parent. It is certain in such cases that the trifoliolate seedling inherits this character from the male parent, and that the embryo from which it grew was developed from the egg cell proper. The other seedlings in such cases which have unifoliolate leaves were doubtless developed from the so-called adventive embryos. The same phenomenon has also been observed where the trifoliate orange was crossed with pollen of the common orange and also in hybrids of the tangerine orange crossed with the common orange (fig. 12). The observations have been sufficient to establish its common occurrence in citrus hybridization. Attention was called to this phenomenon by one of the writers[a] in February, 1900.

In hybridizing citrus fruits to secure improved sorts this effect unfortunately causes serious complications. In many cases citrus hybrids resemble the female parent in foliage characters, or the parents differ so little in their foliage characters that the hybrid can not be clearly distinguished, and it may thus be seen that until the seedlings fruit it is impossible to determine whether they are true hybrids or simply false hybrids developed from adventive embryos. It will thus be unavoidable in such work to grow many seedlings which come from adventive embryos and which are not true hybrids. Such false hybrids ordinarily would not be expected to give valuable varieties, and growing them greatly adds to the trouble and expense.

The increase in vigor which is commonly exhibited by hybrids between distinct parents is clearly shown by hybrids between the trifoliate and the common orange. Those which have intermediate characters, showing that they are true hybrids, are almost invariably much more vigorous than the seedlings of either parent. The hybrids which exhibit no intermediate characters and are probably developed from adventive embryos, do not exhibit this increased vigor. Illustrations of this increase in vigor will be given later.

THE CITRANGE, A NEW GROUP OF CITRUS FRUITS.

In the course of these experiments two fruits have been produced which are hybrids between the common sweet orange and the trifoliate orange, and which promise to be of considerable value. They lie

[a] Webber, H. J., Complications in Citrus Hybridization Caused by Polyembryony. Science, n. s., 11:308, February 23, 1900.

about midway between the two parents, but are not sweet oranges, trifoliate oranges, nor lemons, and are totally different from any other group of citrus fruits. It therefore becomes necessary to refer these hybrids to a new group of citrus fruits, and it is proposed to call them "citranges," a term made up of the first syllable of the word *citrus* and the last syllable of the word *orange*. The two varieties which are to be referred to this group are described in detail below.

RUSK CITRANGE.

[PLATES XI AND XII, AND PLATE XIII, FIGURE 1.]

NAME AND ORIGIN.—The Rusk citrange originated as a hybrid between the common orange (used as the female parent) and trifoliate orange (used as the male parent). The trees are far more hardy than the common orange, and produce a fruit intermediate in qualities between the two parents. This being the first hardy orange or citrange produced, and belonging to an entirely new group of citrus fruits which will doubtless become of very great importance in many parts of the world and be improved in a marked degree, has been named the *Rusk*, in honor of the first Secretary of Agriculture, Hon. J. M. Rusk, under whose administration the first work on citrus fruits in Florida was undertaken by the Department of Agriculture.[a]

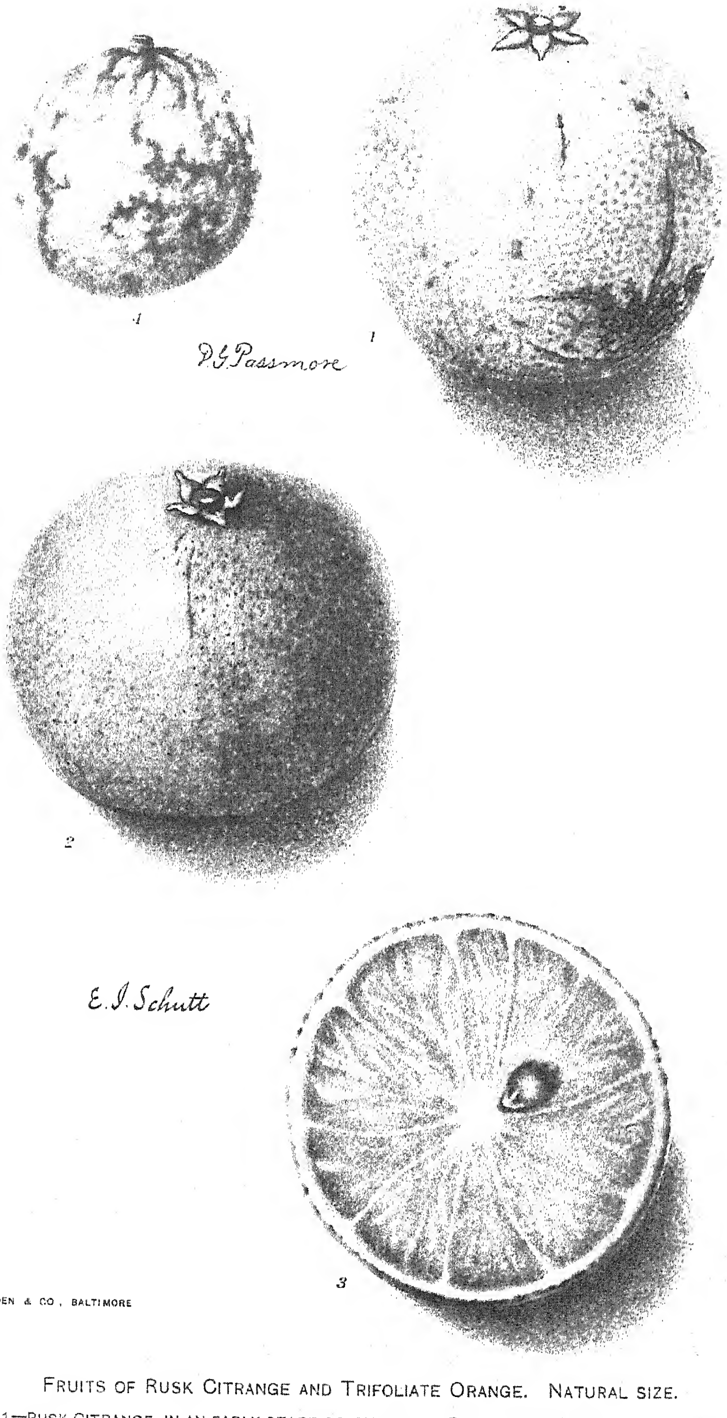
The Rusk citrange was one of three seedlings grown from a single hybrid fruit which developed in the grove of Col. G. H. Norton, at Eustis, Fla., in 1897. Two of the seedlings, from which several budded trees have been grown, resemble the ordinary sweet orange in foliage and general character, and are apparently false hybrids from seeds of adventive, polyembryonic embryos, which, as explained above, are developed from certain cells of the mother tissue without the intervention of the male element. These two seedlings have unifoliolate leaves, and are evergreen like the common orange, and while they have not yet fruited, owing to the fact that they have been several times frozen back, it is not expected that they will produce anything of value, nor, judging from a test already made, will they produce hardier types. The other seedling, No. 716, was a strictly intermediate type, having trifoliolate leaves similar to the male parent, though rather larger (Pl. XI). Even the first leaves of the young seedling exhibited this character, and a photograph of a seedling but slightly over 1 inch high published by the writers at that time plainly shows this trifoliolate character.[b] No. 716 was furthermore much larger and more vigorous than the other two seedlings,

[a]In the Cosmopolitan Magazine for July, 1904, Mr. H. Gilson Gardner referred to this citrange as the *Webber*, but the writers suggest, with the approval of the Secretary of Agriculture, that it be known as the Rusk.

[b]Swingle and Webber, Hybrids and their Utilization in Plant Breeding, Yearbook of the Department of Agriculture for 1897, p. 400, fig. 13.

HYBRID SEEDLINGS OF COMMON ORANGE (FEMALE PARENT) AND TRIFOLIATE ORANGE (MALE PARENT).

[No. 716 (on right), Rusk citrange; Nos. 714 and 715, seedlings from the same fruit as No. 716, but resembling the mother parent.]



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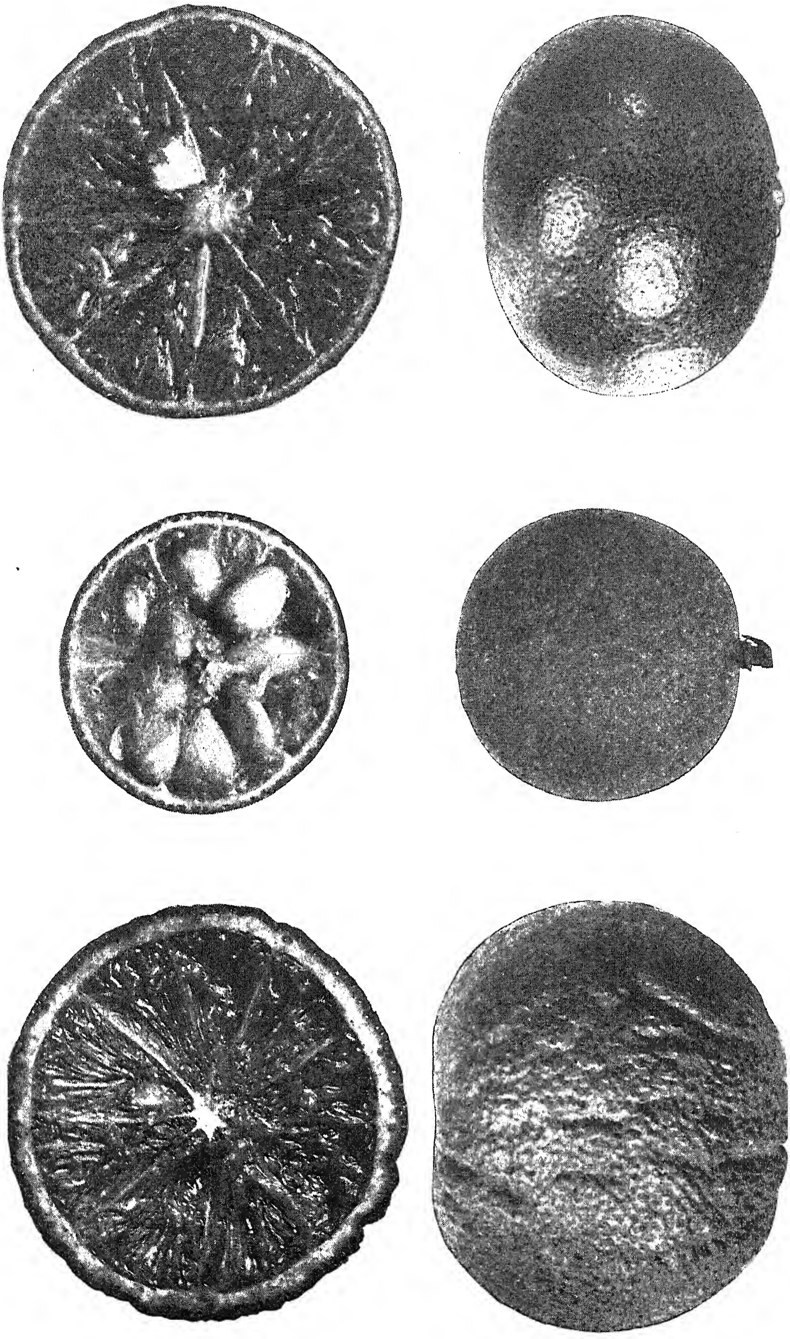
FRUITS OF RUSK CITRANGE AND TRIFOLIATE ORANGE. NATURAL SIZE.

FIG. 1—RUSK CITRANGE, IN AN EARLY STAGE OF MATURITY. FIG. 2—RUSK CITRANGE, FULLY MATURE.
FIG. 3—RUSK CITRANGE, CROSS-SECTION OF MATURE FRUIT. FIG. 4—TRIFOLIATE ORANGE.



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FRUITS OF RUSK AND WILLITS CITRANGES WITH TRIFOLIATE ORANGE FOR COMPARISON.

[Fig. 1, Rusk; fig. 2, trifoliate; fig. 3, Willits. Natural size.]

showing an increase in vigor, which is such a marked character of hybrids in general. Trees were budded with these hybrids in the spring of 1899, in the nursery of Mr. G. L. Taber, at Glen St. Mary, Fla. The first fruits were received in September, 1902, one tree that season bearing about a dozen fruits. In the fall of 1903 the same tree produced about a bushel of fruits, and several other trees, budded on trifoliate-orange stock, gave about a half-dozen fruits each. A similar number was also produced in 1904. There have thus been produced sufficient fruits to afford a fairly thorough test of this hybrid.

DESCRIPTION OF FRUIT AND TREE.—Fruit compressed-spherical or nearly round; small, $1\frac{1}{2}$ to 2 inches in diameter, $1\frac{1}{4}$ to $1\frac{5}{8}$ inches high; color, when fully mature, deep orange, with reddish flush of cadmium orange at apex; surface smooth and glossy, with a few scanty hairs visible under magnification; very heavy, frequently sinking in water; calyx persistent, green, rather larger than that of the ordinary orange; skin adhering very close to the fruit, thin, $\frac{3}{32}$ to $\frac{1}{8}$ inch thick, tender; oil glands small and round; pulp tender, melting, exceptionally juicy (fig. 13); color orange yellow; pulp cells small, similar in shape to those of ordinary orange; segments, 10; membranes thin and tender, thus making very little rag; axis small, $\frac{1}{8}$ to $\frac{3}{16}$ inch in diameter; flavor sprightly acid and slightly bitter; nearly seedless, averaging one seed to two fruits; aroma strong and pleasant, a combination of that of the sweet orange and the trifoliate orange. Tree similar in shape to trifoliate orange, vigorous and hardy, evergreen or semi-evergreen, tall and shapely; foliage dense, leaves trifoliolate and larger than those of ordinary trifoliate orange. Season of maturity very early, from September 1 to November 1.

The fruit of the Rusk is a beautiful little orange of excellent texture and exceedingly juicy. It is rather too sour to be eaten out of hand, but with sugar is very palatable. The bitterness is no more pronounced than in the grape fruit, and the aroma, which is derived largely from the trifoliate orange, is very strong and pleasant. The fruit of the Rusk may be utilized for making citrangeade, similar to lemonade or limeade, or may be eaten with sugar as a breakfast fruit. It also makes excellent pies, preserves, and marmalade, and may be used for general culinary purposes.

WILLITS CITRANGE.

[PLATE XIII, FIGURE 3, PLATE XIV (777), AND PLATE XVI.]

NAME AND ORIGIN.—The second citrange which has given evidence of value has resulted from a hybrid of trifoliate orange with pollen of the common orange, being thus what is known as a reciprocal hybrid of the Rusk citrange. In general it possesses characters intermediate between the two parental varieties, and is similar to the Rusk in tree and fruit characters, yet differing considerably in detail, so that there is no trouble in clearly distinguishing it from the Rusk citrange.[a]

[a] This citrange the writers propose, with the approval of the Secretary of Agriculture, to call the *Willits*. In the Cosmopolitan Magazine for July, 1904, Mr. Gardner called this citrange the *Swingle*, but the writers would prefer that it be known as the *Willits*, in honor of the First Assistant Secretary of Agriculture, Hon. Edwin Willits.

The Willits citrange was one of 40 seedlings from a single hybrid fruit grown and developed in the grove of the late Col. G. H. Norton, at Eustis, Fla. Of the 40 hybrids of this series 11 exhibited characters clearly intermediate between the two parents, being evergreen and having trifoliolate leaves much larger than those of the trifoliate orange (Pl. XIV). The remaining 29 seedlings are all deciduous and have leaves apparently like the typical trifoliate orange. Eighteen of these have fruited and all produced fruits indistinguishable from the trifoliate orange. It would thus seem clear that the 29 which resemble the trifoliate parent are false hybrids, having developed from adventive embryos, as already explained. Four of the apparently intermediate seedlings have fruited, and all have given fruits clearly partaking of the nature of both parents. These are, therefore, certainly true hybrids.

All of the hybrids of this series which show intermediate characters are exceptionally vigorous, showing in this regard also their true hybrid nature. The smallest of them was as large as the largest of the seedlings which exhibited no intermediate characters. The vigor of the young hybrid seedlings in comparison with both parents and the comparative size of leaves is shown in Plate XV. Here No. 845, a cross of two typical oranges and one of the largest of 500 seedling oranges of similar kind, is yet far smaller than the medium-sized true hybrid No. 772. No. 780, one of the largest of the 29 false hybrids, affords a comparison of the size of the true hybrids with the type of the mother parent. The true hybrid No. 772, used here for comparison, is not the largest of the hybrids secured, but is of medium size. The hybrids between distinct species and races are ordinarily intermediate between the two parents and mainly very uniform, so that the hybrids of the first generation usually resemble each other very closely. In the case of the hybrids between the trifoliate orange and the common orange, however, the seedlings have been found to differ from each other very markedly. The fruits of all of those which have thus far come into bearing are essentially distinct in flavor, size, and appearance. The seedlings also differ in tree and foliage characters. They are all similar, however, in having fruits nearly intermediate in size, with some of the bitter flavor of the trifoliate fruit, and in having trifoliolate leaves and semi-evergreen foliage. The difference in foliage characters of some of these hybrids and their parents is shown in Plates XIV and XV.

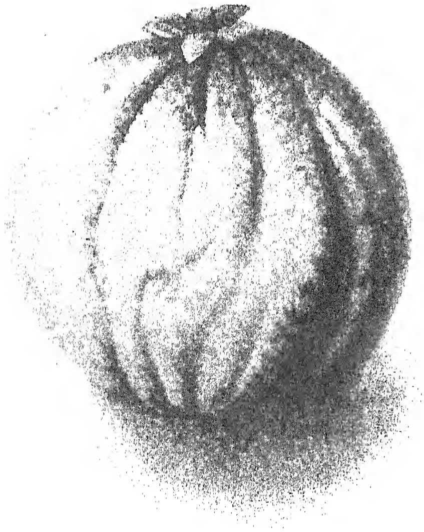
Description of fruit and tree.—Fruit compressed-spherical, or nearly round; small, from $1\frac{3}{4}$ to $2\frac{3}{8}$ inches in diameter (Pl. XIII, fig. 3, and Pl. XVI), and from $1\frac{1}{2}$ to 2 inches in height; color from cadmium yellow to orange; surface rough with deep depressions over the largest oil glands, and with more or less pronounced furrows or ridges running from base to apex; weight medium, about the same as water or somewhat lighter; calyx persistent, with large and fleshy lobes; rind thin, $\frac{1}{8}$ inch in

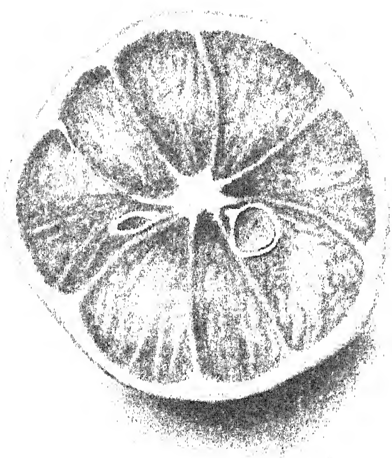
SEEDLING HYBRIDS OF TRIFOLIATE ORANGE CROSSED WITH POLLEN OF THE COMMON ORANGE.

[No. 776, a false hybrid, showing no intermediate characters and having small deciduous leaves; No. 777, seedling of Willits citrange, showing the evergreen foliage and other intermediate characters; Nos. 778 and 779, two seedlings grown from the same seed, No. 779 (on the right), showing intermediate characters, No. 778 (on the left), showing only the normal characters of the trifoliate orange.]

SEEDLINGS OF CITRUS HYBRIDS, SHOWING RELATIVE VIGOR OF TRUE AND FALSE HYBRIDS.

[No. 780, a false hybrid (trifoliate × sweet orange): No. 772, a true intermediate hybrid (trifoliate × sweet orange), with large trifoliolate leaves; No. 845, a cross of two ordinary orange varieties. All seedlings of same age.]





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WILLITS CITRANGE. NATURAL SIZE.

thickness, and tender, not adhering so close to fruit as in the Rusk citrange; pulp translucent, light lemon yellow, resembling the ordinary lemon; segments 6 to 10, separated by thin tender membranes; texture of fruit very tender, being equal to that of the best lemon; axis small, about ⅛ inch in diameter; flavor sprightly acid, similar to lemon, with very slight bitter taste of trifoliate orange; nearly seedless, averaging about one seed to four fruits; aroma mild and pleasant, combining the aromatic resinous odor of the trifoliate orange with the very delicate odor of the common orange. Trees similar to trifoliate orange, vigorous and hardy, evergreen or semi-evergreen, medium height and shapely; foliage dense, leaves trifoliolate and larger than those of the ordinary trifoliate orange (Pl. XIV); season of maturity very early, from September to the last of November.

The Willits citrange makes a beautiful, vigorous-growing tree and gives evidence of being of value as a decorative or lawn tree. The fruit makes a fine drink similar to lemonade or limeade and will be found pleasant as an acid fruit to eat with sugar. It is an excellent substitute for the lemon to serve with fish or oysters and is valuable also for culinary purposes, for which its seedlessness renders it specially desirable. The products made from the Willits citrange are very different in flavor from those made from the Rusk citrange. They possess more nearly the character and flavor of those made from the lemon.

HOW HARDY IS THE CITRANGE?

All of the different citrange seedlings were budded on trifoliate orange stocks at Glen St. Mary, in northern Florida, in the spring of 1899. In January of 1900, when the buds were about 8 months old, a severe freeze occurred in which the temperature went down to about 15° or 18° F. Mr. Taber recorded a temperature of 18° above zero at Glen St. Mary. At Macclenny, Fla., 3 miles east of Glen St. Mary, a minimum temperature of 15° was recorded, while at Lake City, about 20 miles west, the minimum temperature recorded was 17° F., the record at Macclenny and Lake City being made by voluntary observers of the United States Weather Bureau with specially corrected instruments. After this freeze a report from Mr. Taber stated that the foliage on the buds of Rusk (No. 716) and Willits (No. 777) citranges still remained green on the tree, and that the tops were apparently entirely uninjured. All of the hybrids between the trifoliate orange and the common orange which show intermediate characters also remained uninjured and retained their foliage fresh and green, with the exception of an occasional twig which at the time of the freeze was soft and immature.

In this freeze ordinary oranges suffered severely, large buds in many parts of the State being frozen to the ground, and this was the case with ordinary orange buds growing immediately beside the citranges at Glen St. Mary. Although no freeze which has occurred since has been so severe, temperatures of from 20° to 23° have been

several times recorded. In none of these freezes have the citranges been injured, although buds of ordinary oranges have frequently been severely damaged.

Aside from the tests made at Glen St. Mary, Fla., sets of the hybrids which had been made with the idea of producing hardy varieties were sent to the Florida, Georgia, South Carolina, Alabama, and Louisiana experiment stations to be grown and tested in cooperation with the Department of Agriculture. These were planted in March, 1900. At the experiment station at Lake City, Fla., which is in about the same latitude as Glen St. Mary, the trees have passed through the winters since March of 1900 without serious injury. Here the trees have been grown under the direction of Prof. H. Harold Hume, who reports that the temperature has several times fallen to a point where all ordinary orange trees were severely injured or killed without resulting in injury to the Rusk or Willits citranges or to the other hybrids of intermediate nature. Professor Hume reports that the minimum temperature recorded during this period was 21° in December of 1901.

At the Georgia experiment station a set of the trees has been tested under the supervision of Director R. J. Redding and Prof. H. N. Starnes. At this place the temperature fell in February, 1901, to 17° F. above zero, and in December, 1901, to 8°. The majority of the intermediate hybrids passed through these freezes without serious injury. The Rusk citrange was killed back to some extent, but lived through, and is now reported to be in good condition. The trees of the Willits citrange planted at this station have died, but whether directly from the effects of the cold is not certain.

At the Alabama experiment station, Auburn, Ala., a set of the trees has been grown under the supervision of Professors Earle and Mackintosh. At Opelika, Ala., about 10 miles distant, the lowest temperature recorded, since the trees were planted, was 9° F. above zero in December, 1901. Trees of the Willits have remained uninjured, while trees of the Rusk citrange are all reported as dead. Here again, however, it is not clear from the records whether they died as a result of injury from freezing, although this might be assumed. However, almost all of the strictly intermediate hybrids have survived the winters at this place without serious injury.

At the South Carolina experiment station, Clemson College, S. C., a number of the hybrid trees have been grown and tested under the supervision of Prof. C. C. Newman. Unfortunately a complete set of the hybrids was not sent to all of the cooperating stations, owing to a lack of trees of certain numbers. It happened that neither the Rusk nor the Willits citrange was among the number sent to the South Carolina station. However, a number of the intermediate

hybrids similar to the Rusk and Willits citranges have been grown and tested at this station, and have passed through the winters since March, 1900, without serious injury. At this station they have endured a minimum temperature of 6° F. above zero, which occurred in December, 1901.

At the Louisiana experiment station a set of the hybrids, among them the Rusk and Willits citranges, have been tested under the immediate supervision of Dr. W. C. Stubbs. At this station the temperature in December, 1901, fell to 21° F. above zero, and remained below 26° above zero for nearly a week. All of the hybrids survived the freezing without serious injury, although trees of the ordinary orange in the vicinity were in many cases killed.

It will be noticed from the above tests that both the Rusk and the Willits citranges are much hardier than ordinary oranges. While the Rusk citrange endured the freeze of December, 1901, at Experiment, Ga., it was killed, or at least died, at Auburn, Ala. On the other hand, the Willits citrange died at the Georgia experiment station and survived at the Alabama experiment station. It is well known that the condition of a tree at the time a freeze occurs has a great deal to do with its hardiness. Trees which endure the most severe winters at the latitude of Washington, D. C., have been killed in some of the freezes in Florida, owing to the fact that they were in a sappy, growing condition at the time the freeze occurred. That some of these citrange trees were killed, therefore, at certain stations does not indicate that they are tender. The fact that they have survived the same degree of cold at other stations indicates that they would have survived in all cases had they been in a properly dormant condition. It is believed from the evidence now accumulated that these two citranges may be grown without protection throughout South Carolina, Georgia, Alabama, Mississippi, Louisiana, Arkansas, and parts of Tennessee and Texas. It is also probable that they can be grown in parts of Washington and Oregon, and in northern California, which are only slightly too cold for the orange, and in certain irrigated regions of low altitude in Arizona and possibly New Mexico. It will be remembered that the peach tree, which is considered to be fairly hardy, suffered very severely in Georgia in the freeze of December, 1901, to which these citranges were exposed. Large peach trees were frozen to the ground, and the damage to the peach industry was very great. The range of latitude at which the citrange may be safely grown has not been fully determined, but it is believed that they will succeed in any of the above-named places where the altitude is not too high.

OF WHAT VALUE IS THE CITRANGE?

The fruits of the citranges thus far produced are small, acid, and bitter, and from the standpoint of the ordinary orange grower would be considered practically worthless. This opinion, however, would be based entirely on a comparison of the citranges with oranges of fine quality such as are produced in Florida and California. When it is considered that these fruits can be grown through the Gulf and South Atlantic States without protection, where there is now a dearth of acid fruits, their great value can be understood. Both the Rusk and the Willits citranges make a refreshing "citrangeade," similar to lemonade and limeade. It is also very similar to the orangeade

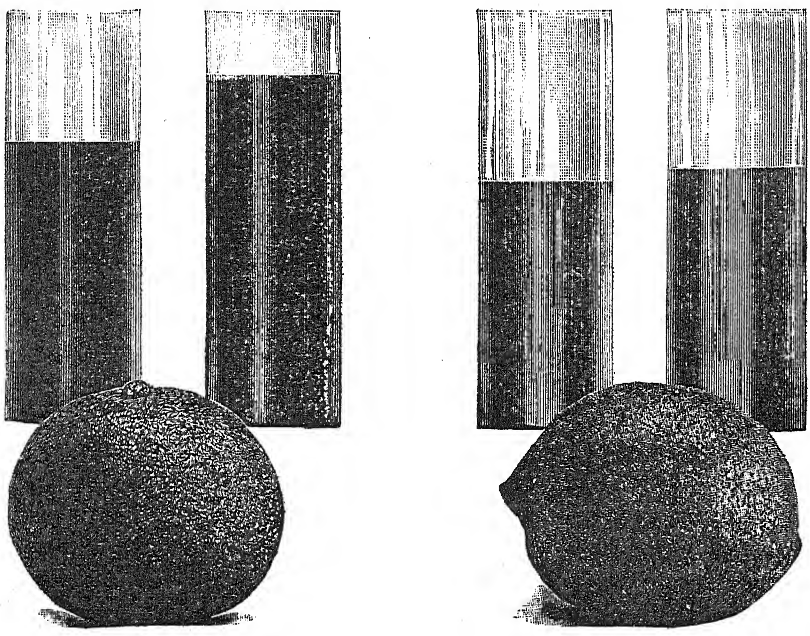


FIG. 13.—Rusk citrange (on left) and lemon (on right), showing comparative amount of juice from fruits of same volume. (Five-eighths natural size.)

made from the native sour oranges of Florida. The citrangeade has been tested by a large number of people, and all who have made a comparison pronounce it fully equal to lemonade or limeade, while some think it superior. The fruits are exceptionally juicy, the Rusk citrange in particular giving a much larger proportion of juice than the best lemons on the market (fig. 13). The fruits make excellent pies and marmalade, and for this purpose they are probably equal to the orange or lemon. Fortunately, the pies and marmalade made from the two fruits are of distinctly different quality, and both differ again from the lemon in this respect. The Rusk citrange

has also been found to make an excellent preserve. The fruits will probably prove valuable for general culinary purposes in the making and flavoring of cakes, for use in making jellies where lemons are now employed, and probably in many other ways. While they are too acid to eat out of the hand they will be found very palatable to any-one enjoying an acid fruit, especially when eaten with sugar. The citrange will probably prove of value mainly as a home fruit for cultivation throughout the Southern States mentioned above, where the sweet orange, the lemon, and the lime can not be grown. A few trees should be cultivated in every yard in this section. The trees are attractive in shape and semi-evergreen, so that they will make desirable lawn trees. Wherever a home can be supplied with them, it will be possible on the warm days between the 1st of September and the 1st of November to pick a few fruits and make a desirable, refreshing beverage. It is believed that they will prove a decided boon to a very large section of the country. While the fruits already obtained present results far-reaching and important, even more striking and valuable results will doubtless be obtained when seed from these fruits can be grown and selections of the best citranges made from among their progeny. These two citranges, it is confidently believed, will be the progenitors of a large and numerous group of hardy, edible fruits.

The Tangelo, a New Group of Loose-Skinned Citrus Fruits.

During the course of these experiments a hybrid has been produced between the pomelo and tangerine which occupies a position intermediate between these two well-known fruits. It is neither a pomelo nor a tangerine, but is different and unique and bids fair to take a place by itself. The fruit is intermediate in size between the two parental varieties, has the easily removable rind of the tangerine, and in flavor is somewhat sweeter than the pomelo, with less bitterness. It is distinct from any of the various groups of citrus fruits and should, therefore, be referred to a new group. The term "tangelo" is suggested by the writers as a name for this group of loose-skinned fruits, which lie midway between the pomelo and tangerine, the word being a combination of the first syllable of the word *tangerine*, with the ending of the word *pomelo*. A variety of citrus fruits known as the "nocatee," which has already been described and introduced, is apparently somewhat similar to this fruit and is evidently a hybrid between the tangerine and pomelo. This and the new Sampson tangelo, which is described below, are at present the only two varieties that can be referred to the tangelo group.

THE SAMPSON TANGELO.

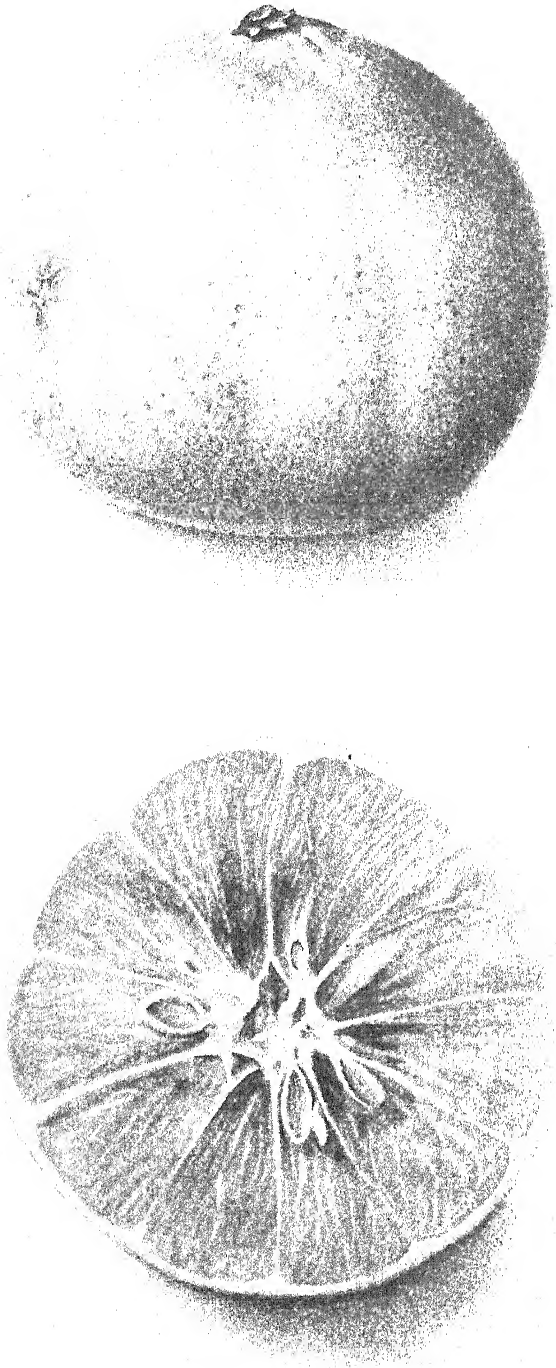
[PLATES XVII, XVIII, AND XIX.]

NAME AND ORIGIN.—The Sampson tangelo is a hybrid between the ordinary pomelo (female parent) and the Dancey tangerine (male parent). The fruit from which the seedlings came was from a cross made in the grove of Mr. Frank Savage, at Eustis, Fla. The hybrid fruit contained a very large number of seeds, 76 in all, which gave a total of 106 seedlings, several of the seeds having produced more than one seedling. A large majority of these seedlings have not yet fruited, but of those that have borne fruit all have the appearance of pure pomelo, except No. 1316, which exhibits characters plainly intermediate between the pomelo and the tangerine, being about midway between the two in size and other characteristics. The color of the fruit is darker orange than the pomelo, though not so red as the tangerine, and the color of the pulp is more nearly like the tangerine than any of the varieties of the pomelo. In flavor it is sprightly acid, but rather sweeter than the pomelo, and it has a slightly bitter taste derived from that parent. Its most pronounced characters, however, are the looseness of the rind and the ease with which the segments can be separated; in these qualities it partakes of the nature of the tangerine. The fruit may be described as a small "kid-glove" pomelo.

The hybrid seedling from which this variety developed was grown and fruited by Mr. F. G. Sampson, of Boardman, Fla., who since the beginning of the citrus experiments of the Department has given material aid in many ways. The writers therefore take pleasure in suggesting for this new tangelo the name of *Sampson*, in recognition of his aid in connection with the experiments.

Of the 106 seedlings of the series from which the Sampson originated, 5 have leaves with narrow, winged petioles, the foliage resembling more closely the tangerine than the pomelo. The only one of these that has thus far fruited is No. 1316, the Sampson, which, as indicated above, in fruit characters clearly exhibits its true hybrid nature. The other 101 seedlings have foliage which would be classed as purely pomelo in character. Only 6 of these have thus far borne fruit, and all of the fruits produced resembled pure pomelo. From these observations it would seem that only the 5 seedlings having tangerine-like foliage are in reality true hybrids. The others are probably false hybrids, developed from adventive embryos.

DESCRIPTION OF FRUIT AND TREE.—Fruit compressed-spherical, slightly drawn out at stem end like tangerine; of medium size, averaging $2\frac{1}{2}$ inches in diameter and about $2\frac{3}{8}$ inches in height; weight from 163 to 248 grams; calyx persistent as in common orange; color chrome yellow, considerably darker than the pomelo, though not so red as the tangerine; specific gravity about the same as water; skin thin, about one-eighth of an inch in thickness, loose and easily removable, like the skin of the



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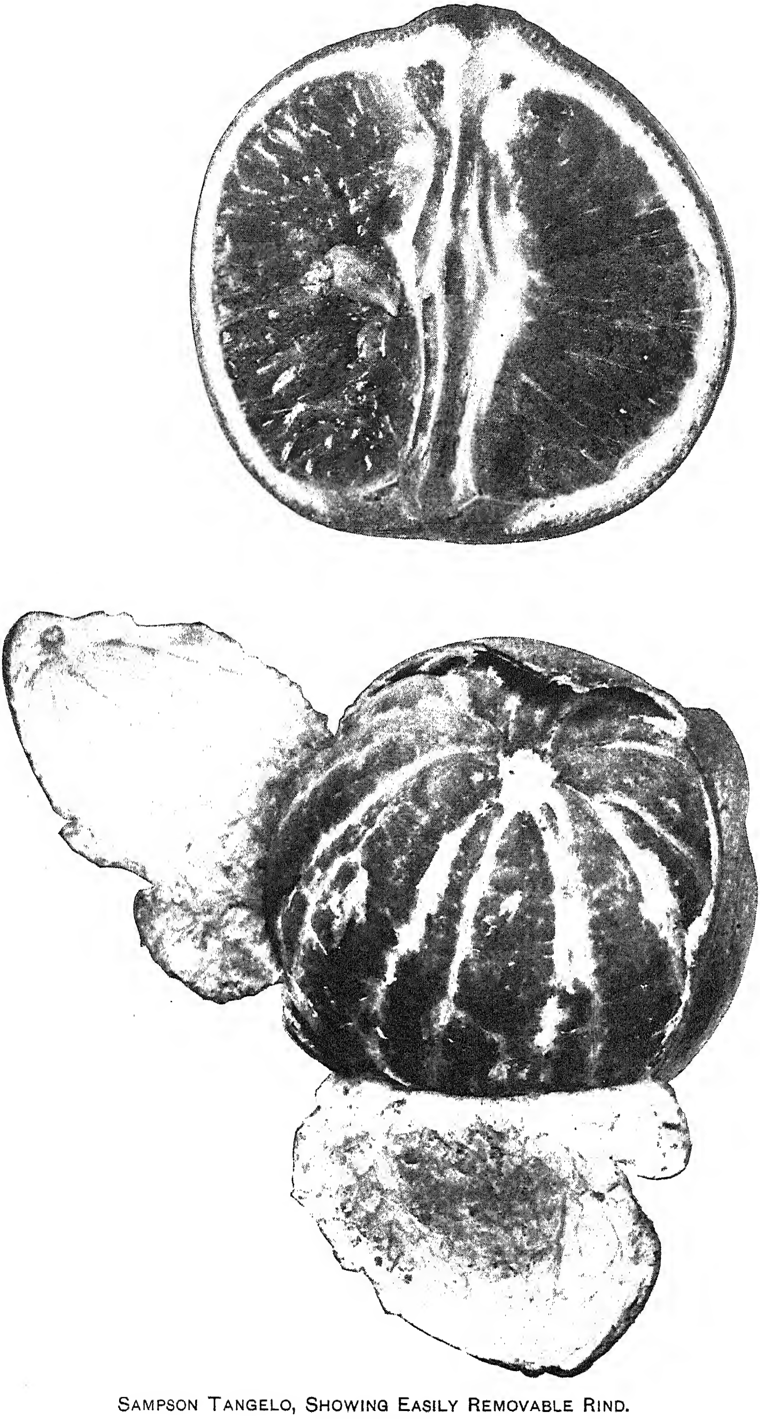
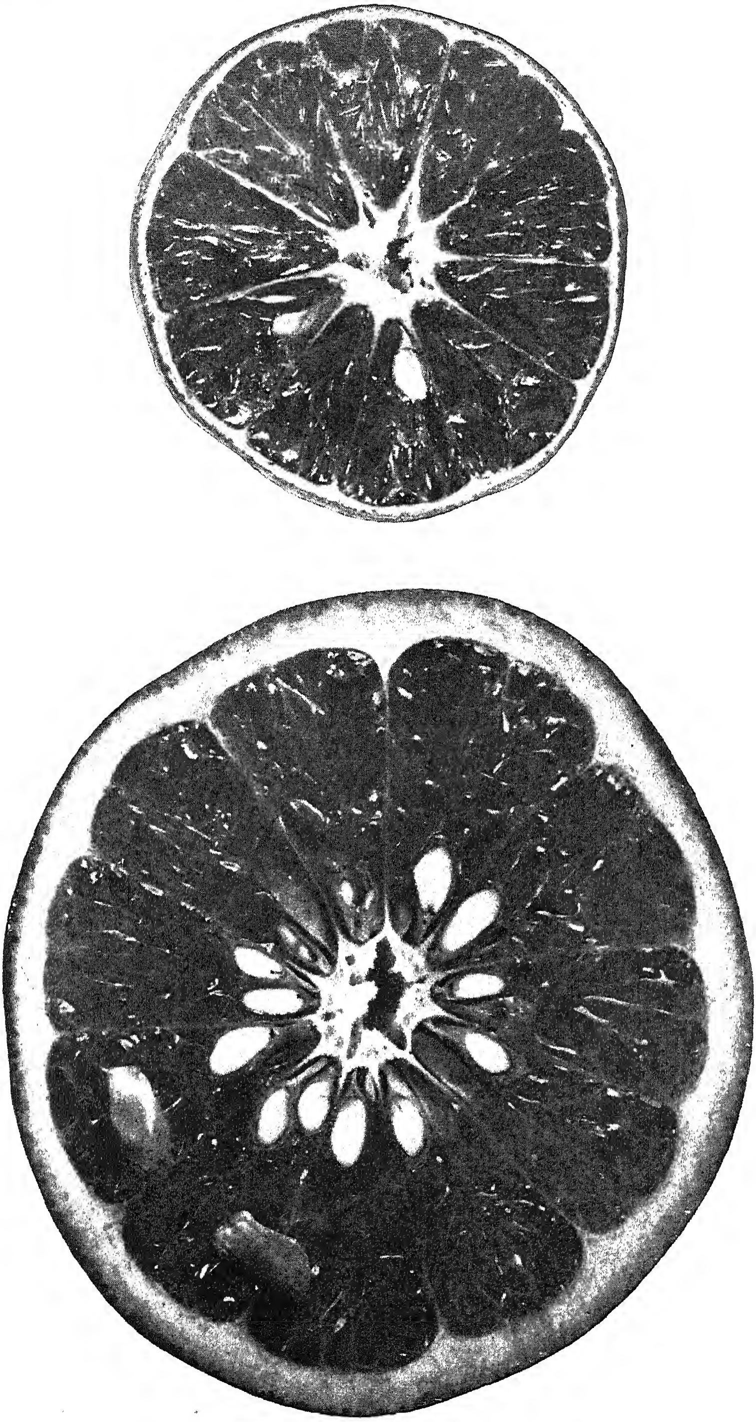
SAMPSON TANGELO. NATURAL SIZE.



SAMPSON TANGELO, SHOWING EASILY REMOVABLE RIND.

[Natural size.]



SAMPSON TANGELO ABOVE; ORDINARY POMELO BELOW.

[Natural size.]

tangerine; surface smooth and glossy; oil glands large and conspicuous, rendering the rind translucent; larger glands oblate spherical, smaller ones nearly spherical; segments 9 to 11, separating easily like tangerine; membranes thin and tender; axes small and compact, about one-half inch in diameter; rag very slight; quality excellent; texture very tender and juicy; flavor sprightly subacid, somewhat sweeter than pomelo, but with more acid than the tangerine and with a slight bitter taste derived from the pomelo; color of pulp, ochraceous-buff to orange buff, differing in this respect from both parents; seeds 10 to 15, medium in size; aroma slight, giving suggestion of both parents; in general appearance very attractive, resembling small pomelo, but of rather darker orange color; tree evergreen, tender, vigorous, and productive, having general character of ordinary tangerine; leaves unifoliolate, with comparatively narrow petioles like tangerine.

USES OF THE TANGELO.

The Nocatee tangelo, which has been previously described, is not familiar to the writers, and they are unable to pronounce on its value. The Sampson tangelo, however, is very likely to become an important commercial fruit. Those who have tasted it pronounce its flavor excellent. Its very attractive appearance and color of flesh, together with the ease with which it can be peeled and the segments separated, favor its growth in popularity. The bitter taste which is so pronounced in the pomelo is in the Sampson tangelo reduced to a suggestion which only adds to its sprightliness. Altogether it is a sprightly acid, highly flavored fruit, being not so acid as the pomelo and not so sweet as the tangerine, and it is believed that many people will prefer it to either of these fruits. It is a vigorous grower and probably productive. It is of course no hardier than either parent and can be grown only in the orange belts of Florida and California. It is believed that the Sampson tangelo will become a popular breakfast fruit, to be used by peeling and separating the segments, as in the case of the tangerine, and eaten by dipping the segments in sugar. The popularity of the pomelo, or grape fruit, is due largely to its use as a breakfast appetizer, and it is recognized as especially beneficial for invalids. It is also thought that the bitter element, probably due to some alkaloid, furnishes a slight healthful stimulation. The pomelo, however, is too bitter and acid to suit the taste of many. The Sampson tangelo, being somewhat sweeter and lacking much of the bitter taste, would seem to furnish a happy medium between the tangerine and pomelo, which would recommend it to many who find the pomelo too harsh. In some ways the flavor of the tangelo resembles the most improved bitter-sweet orange, but is certainly superior to it. Altogether, it is believed that the fruit will occupy a place not now filled by any other citrus fruit and that it will become valuable for commercial cultivation. Its superior quality and the "kid-glove" character of the rind mark it as a distinct and most valuable creation.

NEW TANGERINE ORANGES.

[PLATES XX, XXI, AND XXII.]

One of the primary objects in the citrus breeding experiments was to produce hybrids between the common sweet orange and tangerine in order to secure a new fruit having the size, quality, and flavor of the ordinary orange combined with the loose, easily removable rind of the tangerine. A few of these hybrids have now fruited, and two of them, crosses of the Dancey tangerine with pollen of the Parson Brown orange, have produced fruits which are of considerable value. Both of these seedlings were grown from one fruit which was the result of a cross made in the grove of Mr. W. K. Trimble, of Braidentown, Fla. While the fruits were supposed to be hybrids, they nevertheless resemble the tangerine orange in all important characters, differing from the Dancey tangerine, which was used as the mother parent, mainly in being larger and considerably earlier in time of maturity and in being of rather better quality.

THE WESHART TANGERINE.

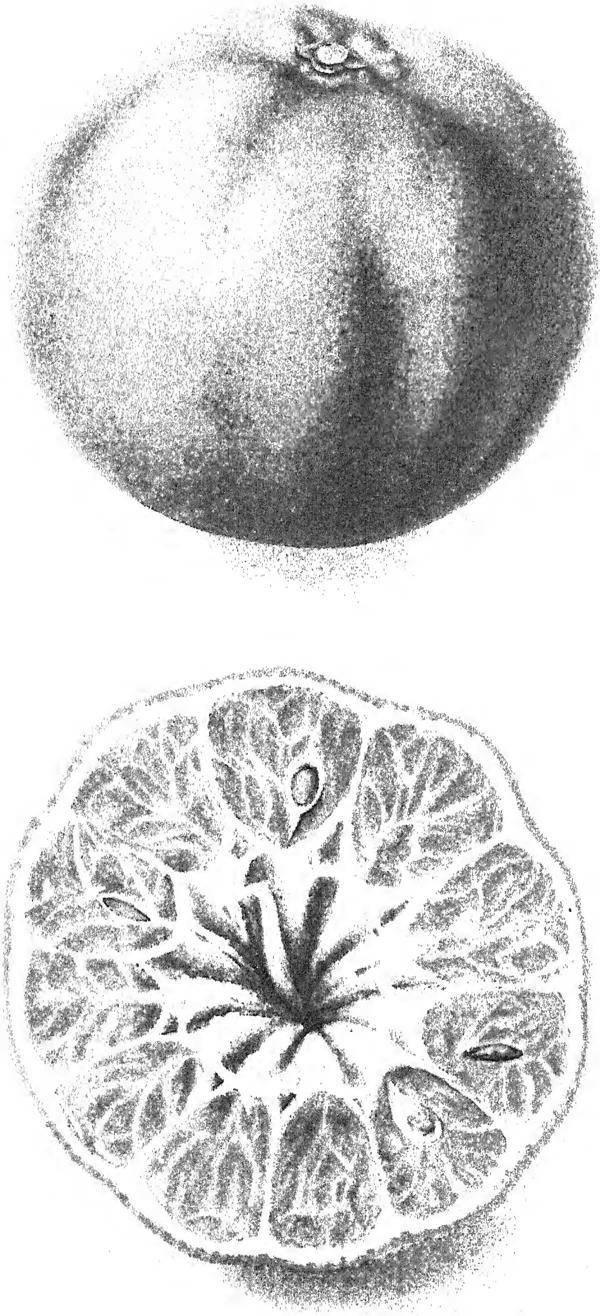
NAME.—One of these new tangerines, the Weshart (Pls. XX and XXI), is named in honor of Mr. W. S. Hart, of Hawks Park, Fla., in recognition of his valuable assistance in these experiments. Both of the new tangerine oranges were grown and fruited under his supervision.

DESCRIPTION OF FRUIT AND TREE.—Fruit compressed-spherical, slightly protruded at stem end and somewhat depressed at the apex, having the same general form as the tangerine. Size from $2\frac{1}{2}$ to $3\frac{5}{16}$ inches in diameter, averaging about 3 inches. Height from $2\frac{1}{4}$ to $2\frac{7}{8}$ inches. Color deep orange red, like tangerine. Surface smooth, glossy, and very attractive, much smoother than the Trimble tangerine, to be described later. Rind loose, as in other varieties of this group; thin, from $\frac{3}{32}$ to $\frac{1}{8}$ inch thick. Oil glands medium size, surface of rind slightly sunken over the largest. Segments mainly 10, easily separable. Membranes tender. Axis hollow, from $\frac{3}{4}$ to 1 inch in diameter, star-shaped. Rag tender and in moderate quantity. Quality and texture excellent. Flavor sweet, subacid, very juicy. Bouquet characteristic and very pleasant. Color of pulp buff orange; cells small like ordinary tangerine. Seeds few, from 9 to 15. Tree vigorous and prolific. Foliage branching, and shape of tree like the tangerine. Season very early for tangerine.

The Weshart tangerine is a delicious fruit of exceptionally fine appearance and flavor. Its large size, superior quality, and earliness indicate that it will prove of great value for general cultivation in orange regions. In general it is smoother in surface and rather smaller than the Trimble tangerine, but is apparently superior in flavor.

THE TRIMBLE TANGERINE.

NAME.—The Trimble tangerine (Pl. XXII) is named after Mr. W. K. Trimble, of Braidentown, Fla., in whose grove the original hybrid was produced. The resulting seedling was grown and tested in the grove of Mr. W. S. Hart, of Hawks Park, Fla., as was also the Weshart tangerine.



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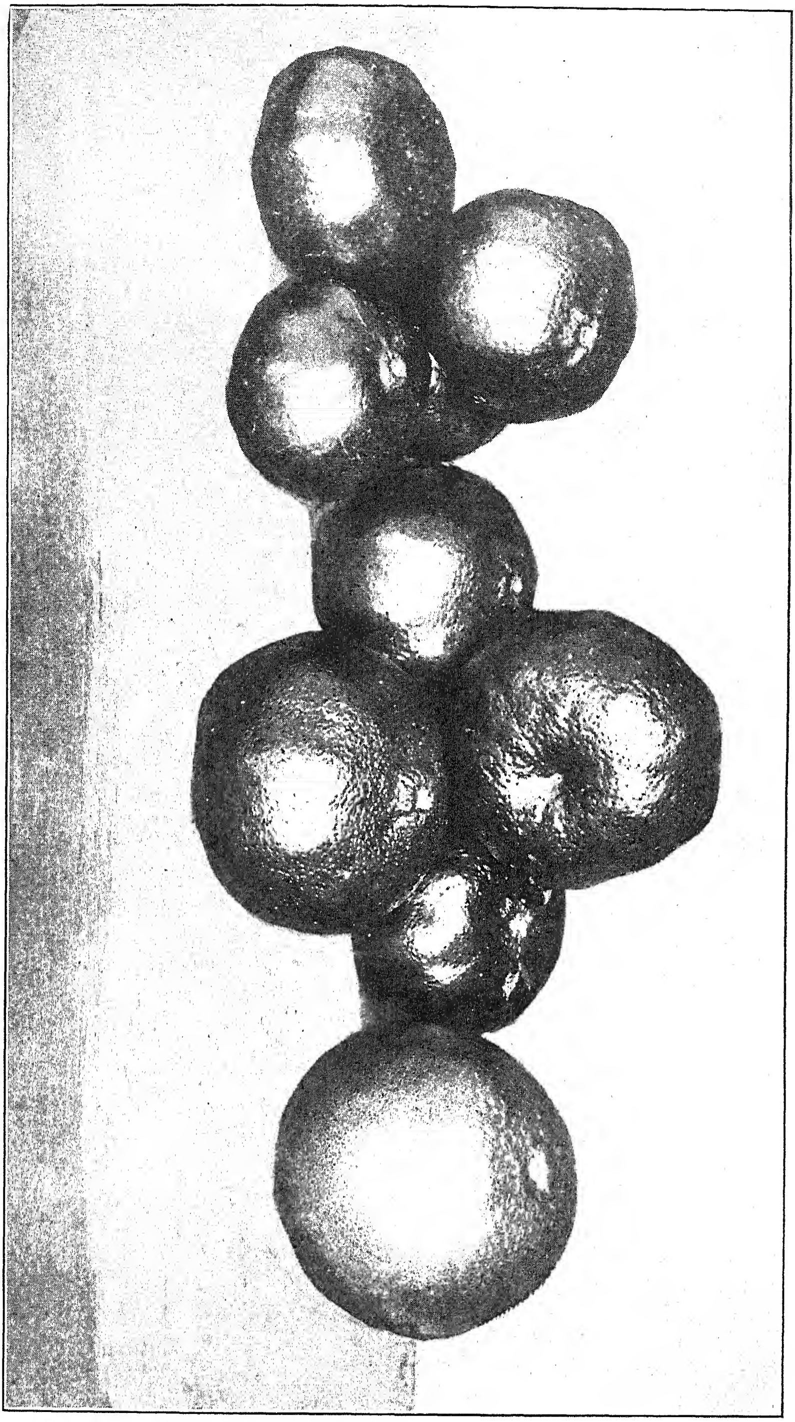
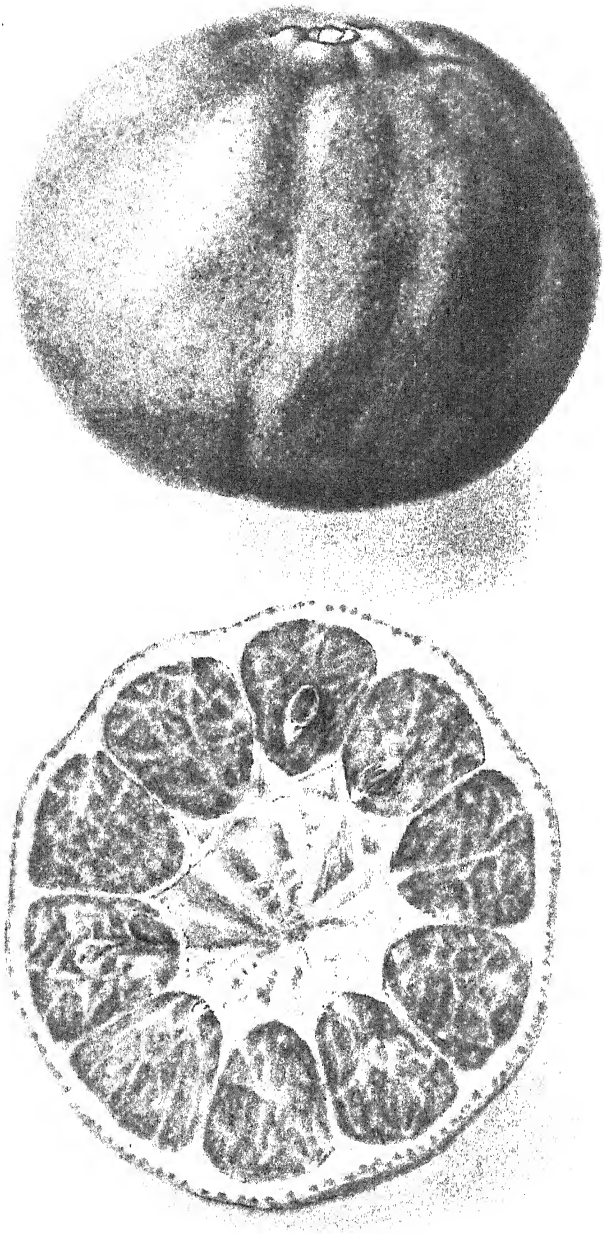
WESHART TANGERINE. NATURAL SIZE.



GROUP OF WESHART TANGERINES (CENTER) WITH PARENT VARIETIES, TANGERINE (ON LEFT) AND PARSON BROWN (ON RIGHT).



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TRIMBLE TANGERINE. NATURAL SIZE.

Description of fruit and tree.—Fruit compressed-spherical, of same shape as the Weshart tangerine, and with slightly protruded stem end and depression at apex. Size large, from 3 to $3\frac{5}{8}$ inches in diameter and from 2 to $2\frac{3}{8}$ inches in height. Heavy, averaging about 5.6 ounces. Color deep orange red, like Dancey tangerine, or slightly darker. Surface somewhat rough and bumpy, in larger specimens similar to King orange; frequently with slight grooves running from base to apex. Oil glands small, with the surface of the rind slightly sunken over the larger ones. Rind loose, thin, $\frac{3}{32}$ to $\frac{1}{8}$ inch in thickness. Segments 9 to 11. Membranes thin and tender. Axis $\frac{3}{4}$ inch in diameter and hollow. Rag comparatively little for fruit of this class. Flesh deep orange yellow and very attractive, tender, and juicy. Pulp cells medium size. Flavor sprightly acid and excellent, with pronounced bouquet. Seeds few, averaging about 10. Tree vigorous and prolific. Foliage branching, and shape of tree like Dancey tangerine. Season of maturity very early for tangerine.

The Trimble tangerine is a fine large tangerine, the rough, bumpy appearance serving to distinguish it from other tangerines, and at the same time not detracting from its appearance. In general the fruits are somewhat larger than those of the Weshart tangerine, but are slightly inferior to them in flavor.

GENERAL QUALITIES OF NEW TANGERINES.

The Weshart and Trimble tangerines, it will be seen from the above descriptions, differ from other varieties of tangerines primarily in being larger and earlier and more highly flavored. Fruits of these two varieties have been received in some quantity for the past two seasons, and have been compared with those of the Dancey tangerine, grown by Mr. W. S. Hart in the same grove, and with the best tangerines that could be procured on the market. In every case they have been superior in color, size, and flavor. In Mr. Hart's grove they have uniformly colored up and ripened about two weeks earlier than the Dancey tangerine, and it would thus seem that they may be highly recommended for general culture. They have not been tested in any other parts of Florida nor in California, and it can not be definitely stated what they will do under different conditions. The Dancey tangerine, however, is generally cultivated, and it is believed that the new fruits will prove superior to this variety in almost every respect. While these two tangerines developed from a fruit of Dancey tangerine crossed with pollen of Parson Brown, they show no clear indication of intermediate characters (Pl. XXI). They are in every respect, so far as can be judged, true tangerines. The Parson Brown orange, which was used as the male parent, is a typical orange and one of the earliest varieties cultivated. The new fruits are larger than those of the tangerine, and it may be that the large size, and their earliness, are qualities derived from the Parson Brown. If it were not for the possibility of their having developed from adventive embryos, this would be the normal conclusion. It is, however, impossible to determine this matter from the characters exhibited by the trees up to the

present time. As the trees mature other characters may become visible which may throw some light upon this point. Practically speaking, however, it does not matter whether the new fruits have any orange blood in them, so long as they possess valuable qualities. The Weshart and Trimble, it should be remembered, are tangerine varieties, and, like the ordinary tangerine or common orange, can be cultivated only in Florida and California, where citrus fruits are ordinarily grown. They are unhesitatingly recommended for further testing and cultivation in these sections.

THE RELATION OF BIRDS TO FRUIT GROWING IN CALIFORNIA.

By F. E. L. Beal,
Economic Ornithologist, Biological Survey.

INTRODUCTION.

When settlements are made in a new country, much of the forest is usually cut away and large areas of open land are plowed and brought under cultivation. This results in the destruction of great numbers of native shrubs, weeds, and grasses and the substitution of various new and exotic plants and trees. Coincident with this change in the vegetable life, and as a necessary consequence of it, come great changes in the conditions and distribution of animal life. Some species may be greatly reduced in numbers, restricted in distribution, or perhaps exterminated, while others become more abundant and more widely distributed. The reduction in numbers may occur from actual killing, from a loss of natural breeding sites through clearing and cultivation, or from a lack of sufficient food supply owing to the same cause. These factors, however, may act in an exactly opposite way, as when cultivation and planting offer to other species greater facilities for breeding or afford a more abundant supply of food. These considerations probably furnish an adequate explanation for the great devastations of crops by birds that were observed soon after the first settlements on the Atlantic seaboard, and then successively in each tier of States to the westward, as they were gradually settled, until the Pacific coast was reached.

In the early days of agriculture in California, when the native grasses and weeds of the fertile valleys were destroyed to make room for fields of grain which soon grew to vast proportions, many species of birds, notably blackbirds and quail, found themselves suddenly confronted with a supply of new and delicious food, surpassing in abundance anything they had known before and far more easily obtained. Naturally they preferred the cultivated grains (wheat, barley, and oats) to the wild oats (*Avena fatua*) upon which they had so largely depended. Still later, when many of the grain fields gave way to extensive orchards, which gradually crept up the hillsides and into the canyons, other species of birds began to utilize the new kinds of

food and also the nesting sites afforded by the orchard trees. Species that had previously attracted little attention became suddenly of great interest from their destructive habits, and no doubt in a few years increased in numbers because of the increased food supply, the facilities for nesting offered by the fruit-bearing trees, and the protection unintentionally afforded by man, who had either killed or driven off their natural enemies. This last factor probably is more potent in furthering the increase of small bird life than is ordinarily appreciated. One of the first acts of the pioneer settler and his successors, after the destruction of the forest, is the extermination of the native species of mammals, such as coyotes, foxes, wild cats, skunks, minks, and weasels, all of which subsist to some extent upon birds or their eggs. At the same time the birds of prey, such as hawks and owls, are also much reduced in numbers, both intentionally, through a misapprehension of their true value, and incidentally, through the destruction of their favorite haunts. Since birds of prey seldom nest near the abodes of man, the small birds that resort to these places for breeding are as a result protected.

MIGRATION OF BIRDS.

Owing to its extent and varied topography, California is rich in birds, both in species and individuals, and their movements are more complex than in the eastern part of the United States. The regular migration north in the spring and south in fall, which is the law over the greater part of the country, is here supplemented, in the case of many species, by a partial east and west migration from the mountains where they breed to the valleys where they spend the winter. Here altitude, rather than latitude, governs climate, which fact leads to many peculiarities in distribution and complicates the study of birds in their economic and other relations. Besides the somewhat irregular migrations, there have been at times remarkable flights of a single species, for whose sudden appearance it was difficult to account. Such was the flight of mountain tanagers (*Piranga ludoviciana*) that appeared in the valleys in May, 1896. In several parts of the State they were seen in immense numbers, and often in localities where previously they had been but rarely observed. Their appearance was about coincident with the ripening of the cherry crop, to which in some places, in spite of the fact that they were shot in great numbers, they did much damage.

REASONS FOR DEPREDATIONS BY BIRDS.

The failure of some usual source of food supply may sometimes lead birds to injure crops upon which they do not commonly feed and inflict serious losses, while under ordinary circumstances the injuries would be too slight to be noticed. Such failure of customary food

supply may explain the depredations of robins upon olives in the fall and winter of 1900–1901, when thousands of the birds visited the orchards in the Santa Clara Valley, the region about Santa Barbara, and other parts of California, and did an immense amount of harm. In that year it was as much as the olive growers could do to save part of their crop. Since then no case of excessive loss of olives has been reported, though some damage has been done.

The amount of injury inflicted by birds often depends upon the geographic position of the particular crop upon which they feed. Orchards situated in the midst of a treeless plain will be infested by such birds as can live in them during the breeding season, and may be visited and damaged by others during the migration. On the other hand, fruit that is grown near or in bushy canyons or on wooded hills will be taken by birds that live in such places and that retire to their usual haunts after eating their fill. It is also observed that a stream flowing through an area of orchards may harbor in the shrubbery on its banks many birds that do not live in the orchard itself.

From these considerations it may be concluded that bird depredations may arise: (1) From the settlement of a new region and consequent introduction of new products, accompanied by a decrease in the native sources of food supply, destruction of enemies, and a general overturning of other natural conditions; (2) from failure of the normal food supply, causing in some cases a migration in search of food, in others simply an attack upon some product that the species does not usually eat; and, (3) from proximity of the bird to the food, in which case the bird naturally feeds upon that which is supplied in greatest abundance and in the most available form.

INVESTIGATION BY BIOLOGICAL SURVEY.

In response to many complaints from fruit growers of the Pacific Coast region in regard to the depredations of birds in orchards and vineyards, an investigation, the results of which will be detailed in a bulletin in course of preparation, was undertaken by the United States Biological Survey. The writer, having been assigned to this work, spent about eleven months, including the fruit seasons of 1901 and 1903, in California. He visited the most important fruit-growing regions of the State, inspected hundreds of orchards, and interviewed an even greater number of fruit growers.

The most uniform kindness and courtesy were everywhere extended him, and every facility for acquiring information was placed at his disposal by the owners of orchards, even to a suspension of the customary rules with regard to trespass and shooting on private grounds. In addition to the knowledge gained by field work, stomachs of all the important species of Pacific Coast birds have been collected and examined, and their contents are being tabulated

CONDITIONS IN CALIFORNIA COMPARED WITH THOSE OF THE EASTERN STATES.

Before proceeding to a consideration of particular species of birds, one point should be especially noted in connection with the subject of the relation of birds to fruit in California: Those parts of the State that are utilized for fruit growing are not so well supplied by nature with wild fruits on which birds may feed as are the fruit-growing areas of the Eastern States or even of those farther north on the Pacific coast. While California has an abundance of wild berries that serve as food for birds, they are not usually found near the orchards and vineyards. In the Eastern States a plentiful supply of fruit of a quality that often compares favorably with the best products of the orchard or garden is usually present, so that it is only where the wild species are exterminated by the clearing up of the country that the birds are forced by necessity to attack cultivated kinds. It is safe to say that in the States east of the Allegheny Mountains thousands of bushels of Rubus fruits (blackberries and raspberries), which grow wild everywhere, annually fall to the ground and rot in spite of the fact that quantities are gathered and eaten by man as well as by birds. The same is true of blueberries (*Vaccinium*) and huckleberries (*Gaylussacia*), which are so abundant in a wild state that, though none are cultivated, they occur in their season in the markets of many of the cities and towns and are eaten in every country home in the region where they grow. In addition to these there are several species of dogwood (*Cornus*), holly (*Ilex*), cherry (*Prunus*), *Viburnum*, and dozens of others, all of which are freely eaten by birds.

Although many of these genera are represented in California, they usually grow in the mountains remote from the fruit-growing districts. In fact, the elderberry (*Sambucus*) and the pepperberry (*Schinus molle*) are the only two uncultivated fruits that have appeared at all prominently in the stomachs of California birds—and the pepper tree is not wild. On the other hand, over forty species of wild fruits have been found in the stomachs of the eastern robins. Thus, it is not surprising that when domestic fruits were first produced on the Pacific coast the birds welcomed them as a desirable addition to their diet. Their previous experience had given them a taste for fruit without fully gratifying their appetite. They now found a supply in abundance and of a quality far superior to anything they had previously known, and the orchardist's crops suffered accordingly.

Another reason why birds attack fruit in California more than in the regions farther east is the dryness of the summers. Scarcity of water probably leads to the substitution of fruit juice for it as a beverage. The securing of water enough to supply the wants of a California bird may sometimes involve a flight of from one to a dozen

miles, while in an eastern State, as Pennsylvania, places are rare in which water can not be obtained within a few rods. In the East, in addition to perennial springs and streams, the frequent rains collect in puddles and in crevices in the rocks and furnish an abundant supply of drinking places for birds, which, though not permanent, are often renewed. However, there is every probability that the California birds find the juice of fruits more agreeable than water, and that when it is at hand they take it in preference. Much of the injury done to such small juicy fruits as grapes and cherries consists of simple punctures in the skin, through which apparently nothing but some fruit juice has been drawn. This certainly renders it probable that the fruit is used as drink as well as food.

NATURAL READJUSTMENT OF CONDITIONS.

In the matter of the destruction of crops by birds, the experience of the whole country shows that, after a certain length of time, nature effects a partial readjustment of the disturbed conditions, so that much of the evil disappears. On the Atlantic side of the continent, with the exception of the ravages of bobolinks in the rice fields of the southeastern coast States, few if any cases are known of the continued annual destruction of crops by birds at the present time; while during the first half of the nineteenth century the various species of blackbirds were a constant menace to grain. The increased density of population has reduced the number of birds, and the increased area of cultivation has destroyed the nesting sites of certain species until something near a balance has been reached. This is likely to occur sooner or later in most cases of disturbed equilibrium, but in the meantime it is well to study the conditions to see if the process may not be hastened.

DAMAGES BY BIRDS GENERALLY.

The study of a number of cases of serious damage done by birds leads to the conclusion that as a rule such injuries are due to the accumulation of a great number of birds of a single species, or of several closely allied species, within a limited area. This is especially true when the birds associate in large flocks demanding a large amount of the same kind of food. Should the birds be seed eaters, they visit the grain fields and leave ruin and destruction in their path; if fruit lovers, they seek the orchard and make havoc with the crop. Instances of this kind are seen in the case of the bobolinks in the rice fields of the southeastern Atlantic coast, the blackbirds in the grain fields of the Mississippi Valley, and the linnets in the fruit orchards of California. It is seldom that a complaint is made of birds in general; one or a few species are usually accused of doing the particular mischief,

the reason for which is plain—too many birds demanding the same things to eat are present. But when several species are present and approximately equal in the number of individuals, such a variety of tastes is to be gratified that no one kind of food is likely to be drawn upon to an undue extent.

BIRDS THAT INJURE FRUIT IN CALIFORNIA.

In northern California, when a fruit grower is asked what birds are most injurious to his crops, he almost invariably mentions first the red-head, or linnet, then successively the blackbird, the oriole, the grosbeak, and the thrush; or, if his ranch is in some narrow valley or canyon, or near wooded hills, he may place the California jay or the quail after the linnet as the next worst enemy to fruit.

THE LINNET.

The house-finch or linnet (*Carpodacus mexicanus frontalis*) is shown by universal testimony and by close observation in the orchards to be easily the leader in the destruction of fruits. The first point to be noted is the bird's wonderful abundance, one of the primary conditions necessary for any species to become injurious. It is a vigorous, hardy bird, a prolific breeder, and a bold marauder upon the orchards. In its general character and its ability to provide for its wants and protect itself it reminds one of the too-well-known English sparrow. Like most of its race, it is provided with a strong biting beak with which it can cut through the skin of the toughest fruit. Its depredations begin with the early cherries and continue as long as fruit of any sort is to be found.

Examinations of the stomachs of linnets show that, as is the case with the majority of the fringilline family, the bird's natural food consists of seeds, with a very small admixture of animal matter. This last aggregates only a little more than 3 per cent of the yearly food and consists principally of injurious plant lice (*Aphides*). The same percentage holds true with the nestlings, which in most other species of the sparrow family are fed largely on insects until they are nearly ready to fly. With the linnet, however, the young are fed practically no more animal food than is eaten by the adults—a fact so much at variance with the usual habit of seed-eating birds as to be remarkable and surprising. The change from seed to fruit on the part of the linnet has undoubtedly been brought about by the introduction of the different varieties of cultivated fruits, which during a part of the year have presented an abundant and easily accessible supply of food. But even now fruit forms only 9 per cent of the annual food; consequently if the birds of this species were not so superabundant, the harm done by them would scarcely attract attention. Their immense numbers cause the comparatively small percentage of fruit destroyed to swell into an

enormous aggregate. In large orchards, however, less complaint against the linnet is made now than formerly, probably owing to the fact that the area devoted to fruit culture has increased more rapidly than the birds, so that their pilferings, being spread over a larger area, are less noticeable. Could any device be hit upon to reduce the species to half its present numbers, there is little doubt that its depredations would be so lessened that, except in the case of the small collections of fruit trees in village lots, they would attract little or no attention. At present it is the owners of these small lots who make the most complaint; for while in large orchards the birds visit many trees, in small gardens they are confined to a few, which they sometimes completely strip.

From the point of view of the fruit grower it may be difficult, in this utilitarian age, to see what useful purpose the linnet subserves; at the same time it must be admitted that it is a persistent destroyer of the seeds of noxious weeds, and from the esthetic side of the question many reasons for its preservation may be adduced, such as its brilliant plumage, sweet song, and pleasing, lively demeanor, which renders the bird a desirable adjunct to rural life. Many people, therefore, even in California, believe that, in spite of its sins, the linnet should be protected. That its extermination is not desirable will be readily granted, but that some reduction in its numbers would be a benefit to the fruit-growing interest can not be reasonably denied. On the other hand, it must be borne in mind that the principal item in the food of the linnet is *seeds of noxious weeds;* the aggregate of these consumed in a year is something beyond calculation and in a measure offsets the value of the fruit destroyed. A comparison of the percentages of fruit and weed seed in its yearly food shows that although the individual fruit growers may suffer, the horticultural interests of the State on the whole must be largely benefited by the linnet. In the humid coast belt, where weeds flourish throughout the summer, there can be no doubt that the bird does far more good than harm.

During the winter and early spring the linnet often turns its attention to buds of fruit trees, and is accused of doing much injury in this way. On this score, however, less complaint is made against the linnet than against the Nuttall sparrow (*Zonotrichia leucophrys nuttalli*) and the intermediate sparrow (*Zonotrichia leucophrys gambeli*), both of which, in the spring migration, have been accused of doing serious injury by feeding on blossom buds. It is doubtful, however, if the loss from this cause is great. Blossom buds are nearly always so abundant that the destruction of a considerable portion of them does not really reduce the crop of fruit. The contents of stomachs of these two sparrows collected in orchards show that, while buds are eaten to some extent, they do not form a large percentage of the food. The birds, however, are so abundant during their journey northward that

even a little damage from each individual might make an important aggregate. Further observation on this point is necessary.

While as a destroyer of fruit in California the linnet unquestionably stands first, it is not so easy to say what species occupies second place, and it is not probable that this place would be assigned to the same bird in every locality; for the economic status of a species varies with its environment, with the result that a bird harmful in one locality may be less so or not at all in another, or vice versa. Furthermore, a bird's economic status in a particular place often varies with the change of season and from other causes.

THE BLACKBIRD.

The Brewer blackbird (*Euphagus cyanocephalus*) is a species of which much complaint is made. It eats an appreciable amount of fruit, especially cherries, but, on the other hand, it eats insects to a considerable extent. During the cherry season the writer observed these birds in the orchards and collected a number of them. They were seen to eat freely of cherries, and the stomachs of those taken showed that a goodly percentage of the food consisted of cherry pulp. While these observations were being made, a neighboring fruit raiser began to plow his orchard. Almost immediately every blackbird in the vicinity was upon the newly opened ground, and many followed within a few feet of the plowman's heels in their eagerness to get every grub or other insect turned out by the plow. It is probable that a thorough investigation of the food habits of the Brewer blackbird will show that by its destruction of injurious insects the species, on the whole, pays well for what fruit it takes.

THE BLACK-HEADED GROSBEAK.

The black-headed grosbeak (*Zamelodia melanocephala*) is another frequenter of orchards, and often nests in them. It is furnished by nature with a beak with which it can bite the toughest fruit; and undoubtedly it takes its share, though no more than may be reasonably allowed, in view of the fact that it feeds largely on the black olive-scale. But scales are not the only pests the grosbeak destroys, for caterpillars of various kinds and the pupæ of the notorious codling moth are freely eaten; and any bird that helps to destroy this last insect, the curse of California apple culture, will be hailed as a blessing in spite of any shortcomings it may have.

THE CALIFORNIA JAY.

After the increasing orchards had been extended from the open level lands to the canyons and hillsides, the fruit trees were brought close to the timber and chaparral, the natural haunts of several species of birds eager to take advantage of the new food. Prominent among

these was the California jay (*Aphelocoma californica*). It is possible that the jays first visited the orchards for the purpose of ravaging the nests of the smaller birds that breed there, and that on these visits they got their first taste of cultivated fruit and acquired an appetite which later, through the further development of the orchard industry, they were fully able to gratify.

While the linnets are the cause of most complaint, being more universally distributed than the jays, they probably are no more destructive than the larger birds, which undoubtedly carry off much fruit that they never eat. On one occasion the writer watched for some time an orchard of prune trees situated where a ravine or small canyon opened into a larger one. The fruit on these trees was just beginning to ripen. Two continuous lines of jays were seen passing, the one up, the other down the ravine to the orchard. Each bird of the line going up carried a prune in its beak, while the other line returned empty-mouthed. Although this work was watched for only a short time, there is no reason to doubt that it was carried on for some hours each day. In view of the fact that the stealing began several days before the prunes were ripe enough to pick, the result may be easily calculated. A similar observation was made in a cherry orchard in a canyon near the woods. The jays were making havoc with the fruit, and every bird that left the orchard of its own accord carried off a cherry.

On another occasion seven jays were successively shot from one prune tree within a period of fifteen minutes, the birds continuing to come unwarned by the dead bodies of their predecessors, which lay ungathered on the ground. The habit of carrying off the fruit they steal renders the jays much more destructive than if they ate their booty upon the spot. They are believed to eat but little of the hoarded fruit, which in the case of soft fruits must soon rot. It is likely that the birds hoard fruits through a misdirected instinct, having been in the habit of storing acorns and other nuts that keep perfectly. In addition to what they eat and carry off, the jays, like the linnets, peck a great deal of fruit which they injure no further, but which is spoiled as effectually as if it were entirely eaten. After the prune crop has been harvested, the almonds begin to ripen, and the jays again gather in the orchards. They strip off the outer husk of the almond, and then placing the nut between their feet, hammer it with the beak until they penetrate the shell and make the kernel accessible. The almonds also are stored in cracks and crannies where, unlike the prunes, they will keep for future use. The jays work at this storing with an energy and perseverence that is in itself commendable. A man who owned a large ranch situated in a canyon had planted near his house a dozen or two almond trees. Although the trees were now well grown and generally bore profusely, he never got any of the

crop; the jays always began on the nuts as soon as they were well grown, but before they were ripe, and did not desist until the last one had been gathered. These instances of observed destruction of fruit by the California jay are local and may be exceptional. Yet, it appears that in places the jays, like the linnets, are superabundant, and that a reduction in their numbers is desirable. The jays do not take kindly to civilization, for as the oak-dotted and brush-covered hills and canyons are cleared and brought under cultivation their favorite nesting areas are destroyed.

THE CALIFORNIA VALLEY QUAIL.

The California Valley quail (*Lophortyx californicus*) sometimes does considerable damage to grapes in vineyards that are situated near wooded ravines or chaparral hills, in which the birds find a secure retreat. Under such circumstances the loss is often very great. In a large vineyard in southern California it is said that they destroyed annually as much as 20 tons of the fruit. One observer states that he once saw a flock of about a thousand quail eating Zinfandel grapes in a vineyard in the central part of the State, and another says that in southern California he has seen as many as 5,000 feeding upon Muscat grapes. In the writer's interviews with California fruit growers only one mentioned the quail as a harmful bird. His ranch was situated along the hills at one side of a narrow valley, and his vineyard was near the top of the hills adjacent to wild grazing land with much chaparral and trees, among which the quail lived. In this case the annual loss was estimated at 2 or 3 tons of grapes.

Six hundred and one stomachs of the California quail have been examined by the Biological Survey. Of the food of the year, 7.60 per cent was found to consist of fruit, but only one one-hundredth of one per cent was identified as grapes. This, however, does not show that the bird does no harm by destroying grapes, for the damage is done during a short portion of the year, mainly in September and October; and, moreover, it is scarcely possible to identify grapes in a bird's stomach unless the seeds have been swallowed, which is not usually the case. If the amount of fruit eaten during this time, though very considerable in itself, be distributed over the whole year, it becomes insignificant. The maximum quantity was taken in the month of December and amounted to 32.40 per cent of the month's food. This must have been mostly waste fruit, as at that season the harvest is over for everything except olives. It is not probable that a bird so large as the quail, and one so easily destroyed, will ever become a serious menace to grape culture, except under unfavorable local conditions. The excellence of the bird's flesh and the popularity of quail shooting as a sport are likely to act as potent factors in reducing its numbers whenever they become too great for the best economic interests.

THE BULLOCK ORIOLE.

The Bullock oriole (*Icterus bullocki*) is a bird of the orchards, but for nesting sites it prefers taller trees. It has been accused of attacking fruit to an injurious extent. Close observation in the orchards and an examination of many stomachs show that it is guilty to a certain degree. It was observed to peck at cherries which had first been broken into by the linnet, and was often seen to come to the ground to get fruit that had been partly eaten and thrown down by the other bird. This implies, perhaps, that the oriole finds difficulty in eating the uninjured fruit as it hangs on the tree. The Baltimore oriole of the East (*Icterus galbula*) has been accused of pecking and injuring grapes, although rarely eating enough to cause serious loss. No special complaint of this kind has been made against the Bullock oriole. It is possible that the western species has not yet acquired the habit. It is one of the most valuable birds of the orchard, for the reason that it eats insects at all times, especially caterpillars, the pests of fruit trees. Like the black-headed grosbeak, the Bullock oriole feeds to a very appreciable extent on the black scale; hence it should not be molested unless it becomes much more abundant and destructive than at present, for even what fruit it does eat appears to be mostly second hand.

THE RUSSET-BACK THRUSH.

In the narrow fruit belt bordering San Francisco Bay the russet-back thrush (*Hylocichla ustulata*) visits the orchards every day while the earlier fruits are ripe, provided the spot is not too far from its favorite nesting place in the bushes or trees on the banks of a stream. The thrush seems to eat most fruit when it has young to feed; but an examination of the stomachs of both young and adult taken at this season shows that the fruit is eaten almost exclusively by the old birds, while, as is usually the case, the young are fed on insects. Just why the adult birds should subsist so largely on fruit during the period of reproduction is not apparent. When the nesting season is past they return to their normal diet of insects. As in the case of the oriole, the fruit eaten by the thrush consists mainly of that first pecked by the linnets. The bird may be observed on the ground eating fallen cherries much oftener than it is seen in the trees, implying that it finds difficulty in breaking the skin of cherries that have not already been broken by some other bird. The liking of the thrush for a nesting site in the vicinity of water keeps it from preying upon orchards situated at a distance from streams. It is probable, however, that this bird, like the grosbeak and oriole, fully pays for all the fruit it takes.

THE ROBIN.

The most striking example of exceptional and intermittent damage to fruit caused by birds is the case of the destruction of olives by robins, to which reference has already been made. In the winter of 1900–1901 the olive orchards in various parts of California were invaded by immense numbers of robins that fed upon the fruits and in some instances destroyed the whole crop. In orchards where some pains were taken to drive the birds away, they still were able to destroy from one-fourth to one-half of the yield. Olive orchards in Santa Clara Valley were especially afflicted. Mr. Paul Masson, who owns two orchards near Saratoga, as quoted by the San Jose Mercury of January 17, 1901, says:

In my largest orchard of about 500 trees, adjoining a larger orchard of about 50 acres on the El Quito farm, which is owned by E. E. Goodrich, are thousands of robins which are destroying all the fruit on the trees. About two months ago I estimated that my trees would yield about 4 tons of olives, but Sunday when I visited my orchard I found the fruit would not be worth picking.

I killed some of the robins, and upon examination found as many as five and six whole olives in the crop of each bird. Besides those which the bird swallowed whole, many olives are pecked so that they are spoiled for market. Sunday there were not less than 50,000 robins on my place, and they were equally as plentiful in the orchard on El Quito farm.

Mr. Edward E. Goodrich, the owner of El Quito farm and olive orchard, as quoted by the same authority, says:

The so-called robin is a destructive pest to an olive orchard. A crop can not be saved when the migration of the robin corresponds exactly with the maturity of the olive, as it does this year, except by immediate picking, which is practically impossible, or by shooting so constantly as to prevent steady consumption. * * * In 1898 my crop was about 130 tons, and should have made about 4,000 gallons of oil. Owing to the lack of rain the result was about 2,750 gallons, of the value of $11,000. Now, that crop could have been wiped out in ten days by robins if they had been here as they were this season and no shooting had been done. So far as my foreman could estimate before the birds descended upon the place, he placed the crop at a probable 3,000 gallons, which means when sold from $12,000 to $16,500, according to prices, and that would have been utterly destroyed but for the constant shooting the last ten days.

As it was, Mr. Goodrich placed his loss on this crop through the devastations of the robins at 25 per cent of the whole, or about $5,000, while his foreman, in an interview with the writer, estimated the loss at 50 per cent. He also said that the birds were so abundant that he killed seven in a tree at a single shot.

The San Jose Mercury also says:

A representative of the Mercury visited the El Quito olive orchard to see what the facts were in this matter. He found a force of men picking the fruit as rapidly as possible, and he also saw thousands upon thousands of robins doing the same thing. On his way out he occasionally saw a single bird on the fence or in a prune tree, but when he reached El Quito the sky was streaked with robins flitting about and having

a gala time of it. Men were scattered about through the orchard with guns, and every few minutes the report of one of the guns would set the robins to flying, but in an instant they would settle down again and resume their feast.

Hon. Ellwood Cooper, of Santa Barbara, one of the largest olive growers on the Pacific coast, in a letter dated January 25, 1901, says:

> The robin is a terrible pest to olives. The birds do not always appear to come to the coast. My first experience was some fifteen years ago. The olives were late in ripening. I was as late as March making oil. The robins appeared to come in by the thousands. My last orchard that year was about one-half mile in length. The pickers were at one end. I had a man with a gun at the other, but they would attack the middle, and when the gunner would reach them they would fly to the end he left. This year they have been particularly bad. My boys reported that the birds, mostly robins, picked more olives than they could. The foreman of the pickers told me that he had knocked from a tree one-quarter of a sack and went to dinner; when he returned not an olive was on the ground. I know that on the ground in one orchard where the rain had caused to fall as many olives as would fill a bushel basket, in a week not one could be seen. The robins do not seem to be able to pick the olives so rapidly from the trees, but peck at those that are commencing to dry, knock them on the ground, then get them. The birds are at this writing in all my orchards by the thousands. They do not appear every year. It has been my theory that the native berries in the Sierra some years are not in sufficient quantities for food.

In his last sentence Mr. Cooper has probably touched upon the true cause of the trouble. The olives are present every year and so are the robins, but it is only occasionally that such attacks take place. The inference is that some normal element of the robin's food sometimes fails, in consequence of which the birds shift their quarters until they find the necessary sustenance. In some respects the case is comparable to that of the bobolinks in the rice fields of the South Atlantic coast, but the injury occurs less frequently. Both cases furnish problems that are difficult of solution.

BIRDS THAT EAT NOXIOUS INSECTS.

After treating of birds that do more or less damage to fruit, it is only fair to briefly notice a few that do not harm fruit, but render efficient service to the fruit grower by the destruction of noxious insects. The family of titmice (*Paridæ*) contains many species, all of which are useful, but among them the bush-tits (*Psaltriparus minimus* and *P. m. californicus*) are preeminent as eaters of insects injurious to fruit trees. Plant lice (*Aphides*) and scales (*Coccidæ*) form two constant and abundant elements of their food. Among these the black olive scale is prominent; while small beetles, bugs, and caterpillars, all injurious species, make up the remainder of the animal food. The plain tit (*Parus inornatus*) is another species whose food is almost entirely composed of injurious insects, and also includes the olive scale. A strong point in favor of the titmice is that they remain upon their range throughout the year, and their good work is continuous.

The kinglets (*Regulus*) are two species of small birds which spend their lives, like the titmice, in searching the bark and foliage of trees for those minute insects that are so difficult for man to destroy and yet are so harmful. The food of these birds is made up of almost the same elements as that of the titmice. Snout-beetles, or weevils, and many other injurious beetles, many harmful bugs (*Hemiptera*), including plant lice and scales, with small caterpillars, and insects' eggs, make up the diet of these birds. To illustrate the efficient work of these little creatures in the way of insect destruction, it may be stated that one stomach contained more than a hundred small, tree-infesting beetles. As nearly all, if not all, of the food of these birds is obtained from trees, especially those in orchards, they are of much value to fruit growers.

The family of birds commonly known as wood warblers (*Mniotiltidæ*) comprises many small and bright-colored species, of which the greater number live in trees, in some cases getting their food there even though they nest upon the ground. As they are of small size, the morsels of their food also are necessarily small and include many insect pests, which because of their minute size are neglected by larger birds and are difficult for man to deal with. In its food habits the Audubon warbler (*Dendroica auduboni*) may be taken as a representative of the family. During fall and winter it is an abundant species throughout the fruit-growing region of central California. Its food consists in part of small beetles, many caterpillars, plant lice, and ants. Of the last it devours an immense number. They are a constant element of the food and many stomachs contained nothing else. In view of the relation of ants to plant lice, it is evident that any agency that will reduce the numbers of these creatures is to be welcomed as a blessing to fruit culture. Many other members of the family are equally useful and as allies of the California fruit grower can not be too highly commended.

FOREST PLANTING AND FARM MANAGEMENT.

By George L. Clothier,
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FORESTRY AND FARM DESIGNING.

Although agriculture stands first among American industries and our production of farm products is greater than that of any other country, the possibilities of the art of agriculture have hardly begun to be understood. That scientific farming will vastly increase the productive power of the land in the United States is beyond doubt. With the advance of knowledge through the discovery of new truths and the advance in practice through the better application of what science has already found out, improved utilization of the country's resources will make room for a future rapid growth in population and wealth, as expansion in territory has made room in the past. Making the same land twice as productive as before is as good as doubling the amount of land, if not better, and we have as yet scarcely scratched the surface of the agricultural resources of the country as a whole. One of the ways in which present methods of farm management may be greatly improved is by better recognition of what may be called farm engineering, or farm designing; and this in turn must give an important place to the consideration of farm forestry.

The farm designer, or farm architect as he might be called, can do much to improve the efficiency of farm operation. Economical management may be attained by a scientific adjustment of the parts of a farm, just as the utility of a great building may be increased by the careful planning of a qualified architect. Several agricultural colleges and experiment stations have recognized this fact, and have given a distinct place to this as a part of the great problem of how to get the most out of the soil. The best opportunities to apply these principles are found in those parts of the West where new farms are being taken up. Generally it is also in these regions that forestry can do most for the farmer, for in the treeless regions, especially, the full development of the country depends in no small degree on the establishment of forest plantations.

From the fact that trees take so much time to grow, the forester who seeks to advise a farmer how he can make trees contribute most largely to his prosperity is compelled to take a long look ahead, and

to consider the whole problem of farm arrangement. In well-settled regions the possibilities of farm designing are apt to be severely limited by what has been done in the past. The location of the buildings, the division into fields, and in many cases the situation of the timber, are now fixed facts. Nevertheless, even here a decided improvement may often be made, as will be illustrated later. What needs to be emphasized now is that even in the older parts of the country a farm should be run according to a definite and carefully considered plan, designed to secure economy of operation and the best use of every part; that tree planting for farm purposes ought always to take into account this plan; and that even where standing timber is already present it may be in the interest of the best use of all parts of the farm to cut this down and plant elsewhere.

THE NEED OF FOREST PLANTING.

Forests are indispensable to the highest material development of any country. We are learning that, besides furnishing the useful timber products resulting from the growth of trees, they conserve moisture, ameliorate climatic extremes, and purify the atmosphere. Where they are not found naturally, or where they have been thoughtlessly removed from wide stretches of country, it becomes desirable in behalf of the public welfare to plant trees in great number. Obviously the benefits of such plantations will be most widely felt if the planting is well distributed over the region. Further, it is a work the benefits of which are shared by all, and which all should join in performing.

The plantations in a definite region should be made after one general plan, in order to allot to each farm its proportionate amount of forest. The method of planting and the position of the planting sites should evidently be made with reference to a system of farm management, since a forest is the most permanent thing that can be planted on a farm. An example of such a plan and such a system is shown later in the present article.

MISTAKES OF THE PAST.

It is unfortunate that a large percentage of the plantations made by farmers have been disappointing. Yet some commercial plantations, such as that of Mr. L. W. Yaggy, at Hutchinson, Kans., have been financially successful.

Farm forest planting has been practiced in some of our prairie States for more than half a century, and great good has resulted from many of the plantations, but the measurable increase in the wealth of the country attributable to forest planting has been small, owing to the choice of poor sites and the use of unsuitable species. The

artificial forests of Illinois would have been worth many times what they are at present if longer-lived and more valuable species had been used in the plantations instead of silver maple or trees of as little worth. Species of the greatest value have often been ignored because of their apparent slow growth, and others, deserving to be classed as "weed trees," have been used in their place. Successful plantations of black walnut, hickory, elm, oak, and other valuable trees are common enough to prove that the slower-growing woods ordinarily pay best. Silver maple, boxelder, and the like are valuable chiefly for firewood, and it is easily possible to overstock the market for cordwood in any locality. Lumber woods, on the other hand, can always be disposed of in any quantity.

A good opportunity for comparison of the relative values of the two classes is afforded by the returns from a 64-year-old stand of black walnut in Morgan County, Ill., and a 35-year-old stand of silver maple in Sangamon County. These were the best groves of each species found in the State during an extended survey made in the summer of 1904. The figures relating to the two tracts are presented in the following table:

Value of planted forests of black walnut and silver maple on the prairies of Illinois.

Species.	Location.	Age.	Area.	Number of trees on area.	Average diameter breasthigh.		
					Dominant trees.	Intermediate trees.	Suppressed trees.
		Years.	*Acres.*		*Inches.*	*Inches.*	*Inches.*
Black walnut..	Morgan County, Ill.......	64	0.6	119	19.0	13.3	9.4
Silver maple ..	Sangamon County, Ill....	35	5.6	1,478	10.6	....	....

Species.	Location.	Number of trees per acre.	Yield per acre.			Total value per acre.[b]	Annual value per acre.[c]
			Lumber.[a]	Fence posts.	Firewood.		
			Board ft.		*Cords.*		
Black walnut..	Morgan County, Ill.......	198	42,000	1,800	15	$1,050	$5.58
Silver maple ..	Sangamon County, Ill....	264	....	....	65	130	2.15

[a] From trees 11 inches and over in diameter breasthigh.
[b] Lumber at $20 per 1,000 board feet, fence posts at 10 cents each, and firewood at $2 per cord.
[c] Interest compounded annually at 3 per cent.

It would be quite as easy to show that the returns from hickory, elm, or some other wood which can be used when no older than the maple would amount to more than those from the latter, but the comparison of walnut with maple serves also to emphasize the greater value of a wood which must be kept until the trees attain a good size. The figures in the last column represent the annual returns from the two plantations irrespective of their age, and are therefore directly comparable.

It is a well-known fact that the great majority of the forest plantations made in accordance with the timber-culture act were failures. Here again the unfavorable results were due to poor sites and ill-adapted species, combined with a lack of care on the part of planters and the dishonesty of entrymen, who regarded this law merely as a means of obtaining title to public land without paying for it.

Plantations made by specialists and designed for a special purpose do not usually require very elaborate planting plans. It is the small woodlot plantation that is to serve many purposes in the economy of the farm which calls for the most careful planning.

WHAT SHOULD BE CONSIDERED IN PREPARATION OF A PLANTING PLAN.

As a machine of production, a farm should have a plan which provides for the best use of its every part. The woodlot or forest plantation should be in a position to contribute to the successful operation of this plan, for the trees may affect the atmospheric drainage, the wind currents, and the humidity of the air about the home. At the same time a planting plan must provide for sites which will produce the best possible growth. The arrangement of the fields and the location of the fences, private lanes, drainage systems, buildings, and farmstead should all be considered before any forest planting is undertaken.

Very rarely indeed have farmers deliberately planned the location and make-up of their forest plantations with reference to the needs, convenience, and economy of their farms, and the relative value and adaptability of the trees to be planted. Woodlots have sometimes been so poorly located as to do actual damage to farms. Cases have been observed in the northern half of the Middle West where windbreaks planted too close to the buildings caused the drifting snow of severe winters to bury the houses 15 or 20 feet deep. In the winter of 1899 a farm house in the Red River Valley, North Dakota, was buried in a snowdrift for three months because a cottonwood grove had been planted too near it. In other cases trees have been planted near tile drains, which the roots clog.

It is probable that not one-tenth of American farms are being operated under any permanent system of management. Before forest planting is undertaken some such system must be adopted, however, in order to make the future existence of the forest plantations possible, for more than half the 355 planting plans made since July 1, 1899, by the Bureau of Forestry, fundamentally affect the future management of the farms. As very few farmers are accustomed to formulating farm plans, the agent of the Bureau of Forestry, besides being called upon to give advice in matters pertaining to technical forestry,

is usually drafted into this service as well. After consultation with the landholder and consideration of all the matters affected by the policy of management, he is able to bring out an orderly arrangement which will permit on the same farm the practice of both scientific agriculture and scientific forestry.

A CONCRETE EXAMPLE.

The planting plan shown in figure 14 was made for a farm in central Ohio, and illustrates graphically the bearing that forest planting may have on the management of a farm. This farm in Ohio contains 375

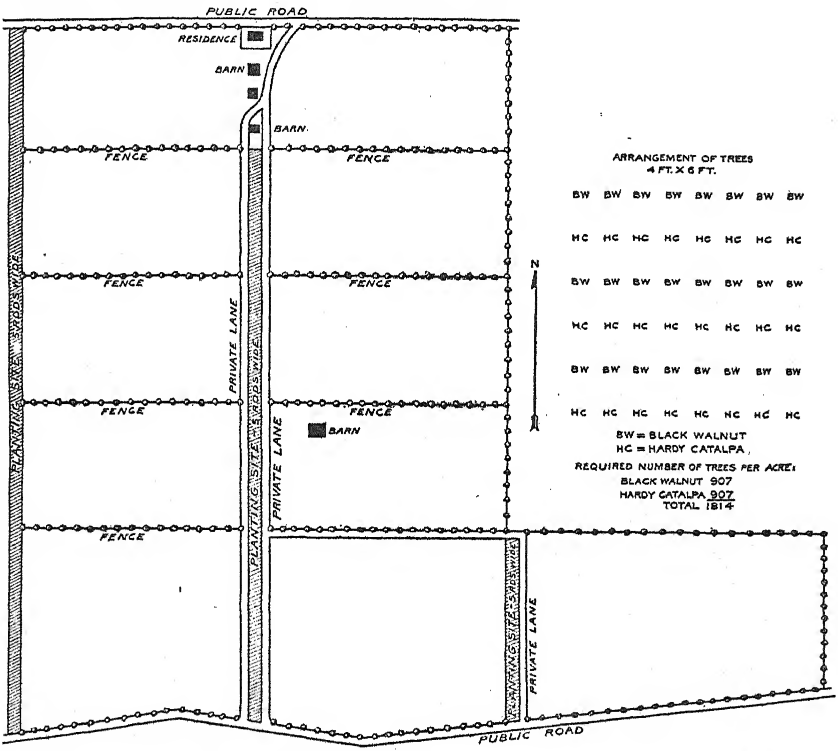


FIG. 14.—Arrangement of forest plantations on a farm in central Ohio to facilitate scientific farm management.

acres, and that part of it which is devoted to agriculture is capable of earning interest on a capitalization of $100 per acre; not a foot of it is unsuited to tillage. That part which was originally heavily timbered has all been cleared, except a bluegrass pasture of 30 or 40 acres which is occupied by the remains of the original forest, consisting of a scattered stand of declining sugar maple and beech trees. This timberland embraces the most fertile part of the farm, and interferes most seriously with the convenient and economical division of

the farm into fields. If the Bureau of Forestry had advised the owner to attempt to rejuvenate the dying trees and to underplant them with expensive nursery stock, the instructions would have been implicitly followed, but such advice would have wrought a positive injury to the landholder. Instead, the planting plan advises that the forest area of the farm be reduced by clearing the only natural timber left standing, and that, instead of retaining the scattered growth now cumbering the pasture, trees sufficient to occupy about half the present forest acreage be planted in such positions as to protect the farm from the severe westerly winds prevailing in the region.

The owner was therefore advised as follows:

(1) The major part of this farm is too valuable for agricultural purposes to be devoted to forestry. The native timber now scattered over the pasture is rapidly declining, and is reduced by every hard storm. No natural reproduction is taking place, and while the land is grazed none can be secured. The location of the scattered trees in the middle of the farm would require expensive fencing in order to protect them from live stock. Thus, it is believed that the rejuvenation of the old forest on this farm is impracticable. Instead, this land, as soon as the old trees have all disappeared or been removed, should be laid out into permanent fields. As every well-regulated farm, however, should possess some timberland to supply it with fence posts and to furnish shade and shelter for live stock, the plantations described on page 261 are recommended. The trees will take up as little room as possible and will not interfere with the tillage of the land, while the arrangement of the fields in rectangular blocks will greatly facilitate the use of modern machinery.

(2) The chief plantations should occupy strips 5 rods wide, running from north to south. One of these strips should be planted on the western border of the farm and another crossing its center, due south of the residence. A third should cut off the block extending east from the southeast corner of the main rectangular tract. In addition to these strips, it is advised that single rows of trees be planted on the division lines between the fields, so that they may be used as live posts upon which to fasten wire to form fences. (See fig. 14, p. 259.)

(3) Black walnut and hardy catalpa should be used in equal proportions for the belts, and should be planted every 4 feet in alternating rows, which should be 6 feet apart. The walnut seed should be planted two years prior to the introduction of the catalpa seedlings, in order to allow the slow-growing walnut to get a start before being crowded by the catalpa. The nuts of the walnut should be collected as soon as ripe in the fall, and should either be stratified[a] in moist sand or planted

[a]Stratification is a method of storing forest seeds to prevent drying out. The seeds are stored in alternating layers between layers of moist sand.

immediately in their permanent site. These nuts should never be allowed to dry out after ripening. They are most easily planted while plowing, by dropping them in a furrow and covering them with the next furrow slice. If walnuts are thus planted, the squirrels are not likely to find them. The ground between the rows during the following two years should be planted with corn, and should receive good tillage. This can best be done by use of the lister. After the catalpa seedlings are introduced no more corn should be planted, but the ground should be cultivated as long as a single-horse cultivator can be run between the rows. Catalpa seedlings 12 to 16 inches tall and one year old should be used. They can be obtained from dealers for $1.50 to $5 per thousand. The labor of planting these seedlings may be performed chiefly by horsepower. Both walnut and catalpa should be planted in accordance with the following diagram:

Mixture of black walnut and hardy catalpa.

[4 feet by 6 feet.]

BW	BW	BW	BW	BW	BW
HC	HC	HC	HC	HC	HC
BW	BW	BW	BW	BW	BW
HC	HC	HC	HC	HC	HC

Required number of trees per acre.

Black walnut	907
Hardy catalpa	907
Total	1,814

By consulting figure 14 the reader will see that the planting plan subdivides this farm into eleven fields—eight rectangular ones of equal area and similar dimensions, and three of nearly equal area but of unlike dimensions. This division will permit the application of scientific crop rotations, the eight rectangular fields being suited to two systems of four-year rotations and the three irregular fields to one three-year rotation. The convenient shape, ease of cultivation, and wonderful fertility of this farm present an excellent opportunity, under the instruction and supervision of the Bureau of Plant Industry, for the arrangement of such rotations of suitable crops.

Trees planted on the lines which separate the fields will serve as windbreaks as well as living fence posts. A good method is to plant Osage orange hedges between the fields, and every 20 feet to allow one of the trees to grow its natural height. The remaining trees should be pruned to a height of 5 feet and kept within proper limits for a hedge. Then, if this growth proves inefficient as a fence, it can be

reenforced by woven wire stapled to the large trees. If the Osage orange is undesirable or a hedge not wanted, chestnut should prove a desirable tree for the fence lines. The young trees should be planted about 20 feet apart, and when they begin to crowd each other every alternate tree should be cut out. Round headed and with sturdy trunks, these trees will form very effective windbreaks for the intervening fields. Their nuts will bring a satisfactory return for the land they occupy, and the trees which are cut out will furnish excellent fence posts. The substitution of straight woven-wire fences for the old zigzag ones of rails transforms the fence lines from breeding places for noxious weeds into productive land upon which the living fence posts grow into a merchantable product.

Such a plan as this fixes the boundaries of the fields, plans the location of the private lanes, and, in fact, forms the skeleton of any future system of farm management that may be applied to this farm.

A MODEL PRAIRIE FARM PLAN.

In order to illustrate a model prairie farm plan made in accordance with sound principles of forestry, figure 15 has been prepared. This farm plan is applicable to a large region in the prairies of the Middle West, where windbreaks are necessary to the full development of the country. It assumes that the land is of uniform condition of soil, and has been surveyed by the rectangular system adopted by the Government. The public roads are supposed to be located on the section lines. The application of this model to a country with its surface broken by creeks or lakes would, of course, necessitate a modification to fit local conditions. The plan is intended merely to illustrate principles.

Four farms of 160 acres each are shown, illustrating an arrangement suitable to each of the four quarters of a section. The farmstead, or that portion of a farm which is occupied by the residence, barn, orchards, gardens, lawn, and feedlots, is here shown as placed at the section corner of each farm. While in a large proportion of cases the location of the farmstead will be determined by the particular conditions, as water supply, topography, etc., an arrangement, where practicable, by which the houses stand on the section corners will be worth considering.

The fields on each quarter section have been laid out to permit the planting of windbreaks to protect the crops from the hot southwesterly winds of summer and the cold northwesterly winds of winter. The farmsteads are also provided with protection from winds. East winds have not been considered, because of their infrequent occurrence, but a general adoption of this plan on all the farms of a region would afford protection from all points of the compass.

The fields, with one exception, are all of the same shape and size, each quarter section being divided into six fields, each 22.1 acres in area. This method of dividing the farm into fields will afford an opportunity for the application of a scientific system of crop rotation, and the fields, being six in number, will permit the application of a compound rotation embracing the use of a perennial crop like alfalfa in

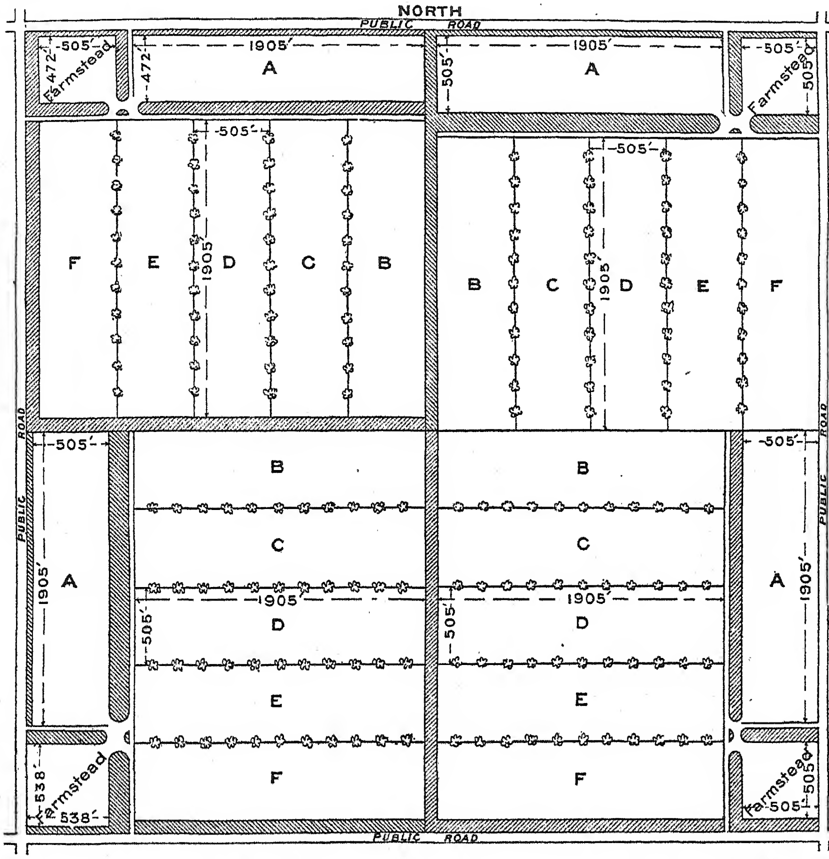


FIG. 15.—Ideal plan of the four quarters of a section, showing location of forest and windbreak plantations, with reference to the farmstead and the fields, *A*, *B*, *C*, *D*, *E*, and *F*, suited to the prairies of Kansas and Oklahoma.

combination with five annual crops, where this is desired. If the use of a perennial is not desirable, the six fields will permit the running of two parallel three-crop rotations.

TREES AND METHODS RECOMMENDED.

The plan provides that the forest trees shall be planted in belts varying from 2 to 8 rods in width, except along fence lines, where they are in single rows. The best results, purely from the standpoint of forestry, will be obtained in the widest belts, since trees are social in their habits. Still better tree growth would be secured by planting

in compact blocks. But as agriculture is the fundamental industry in the region to which this plan applies, the tree planting is designed only to supplement the production of field crops. Eleven or 12 per cent of each quarter section is to be devoted to forest. This is exclusive of the space occupied by the single lines of trees in the fence rows.

The species that may be recommended for this purpose vary for each particular locality with conditions of climate, rainfall, and soil. Circulars 29 and 30 of the Bureau of Forestry, explanatory of exhibit plantations at the Louisiana Purchase Exposition, enumerate sixty different combinations suited for woodlots and windbreaks in different parts of the United States, but do not begin to exhaust the combinations possible. Considering the Middle Western States together, however, the following trees, when placed on hospitable soil fulfilling the requirements of each individual species, may, in the northern half of the region, be successfully grown as windbreaks:

Common name.	Scientific name.
Arborvitæ	*Thuja occidentalis.*
Green ash	*Fraxinus lanceolata.*
Boxelder	*Acer negundo.*
Cottonwood	*Populus deltoides.*
Cork elm	*Ulmus racemosa.*
White elm	*Ulmus americana.*
European larch	*Larix europæa.*
Russian wild olive	*Elæagnus angustifolia.*
Western yellow pine	*Pinus ponderosa.*
Black Hills spruce	*Picea canadensis.*
Laurel-leafed willow	*Salix laurifolia.*
Russian golden willow	*Salix vitellina aurea.*
White willow	*Salix alba.*

In the southern half of the Middle West also, the green ash, cottonwood, white elm, Russian wild olive, and western yellow pine may be successfully grown, and in addition the following species:

Common name.	Scientific name.
Chinese arborvitæ	*Biota orientalis.*
Wild China	*Sapindus marginatus.*
Black locust	*Robinia pseudacacia.*
Honey locust	*Gleditsia triacanthos.*
Mesquite	*Prosopis juliflora.*
Russian mulberry	*Morus alba tatarica.*
Osage orange	*Toxylon pomiferum.*
Persimmon	*Diospyros virginiana.*
Shittimwood (locally Chittimwood)	*Bumelia lanuginosa.*

These lists do not include all of the best timber trees that might be grown in the Middle West, for many valuable timber trees will not endure such severe exposure as a windbreak is subject to.

In the establishment of a windbreak, wisdom is required in the placing of the different species. A windbreak composed of more than one

species is usually the most effective. An excellent method of arrangement is to place the shortest trees in the outside row (toward the prevailing wind), to plant a somewhat taller species next to them, and to place the tallest trees in a third row on the side adjacent to the buildings or the area which is to be protected. This causes the wind to strike the trees as it would strike the face of a steep hill, deflecting its course upward. If the tallest trees of the third row consist of a flexible species, such as cottonwood, European larch, white willow, or honey locust, they will bend before the wind, and act as a cushion to deflect it upward and over the object to be protected. A satisfactory windbreak 5 rods in width, for the protection of the north and west-sides of a farmstead (see fig. 15) and adapted to Minnesota and the Dakotas, is as follows: Plant 13 rows of trees, parallel to one another and 6 feet 10 inches apart. The first two rows on the north and west edges of the belts should consist of Russian wild olive, the third and fourth rows of arborvitæ, the fifth and sixth rows of boxelder, the seventh and eighth rows of white elm, the ninth and tenth rows of white willow, and the remaining three rows of common cottonwood. Such a plantation, when mature, will appear like a wall with a sloping top, the highest side being where the cottonwoods are planted.

Carrying out this same principle for Oklahoma and Texas, with a change in the position of the plantations to afford protection from southwest winds (see fig. 15), the following method is advised: The first two rows on the south and west edges of the belts should consist of Russian mulberry or Osage orange, the third and fourth rows of Chinese arborvitæ, the fifth and sixth rows of black locust, the seventh and eighth rows of green ash, the ninth and tenth rows of white elm, and the remaining three rows of honey locust or common cottonwood.

In southern California, where the damaging winds come from opposite points of the compass (from both the southwest and northeast), a good plan for a windbreak is one in which the tallest, most flexible trees will be in the center rows, so that the species on either side will slope downward toward the outside edges of the belt. For such a windbreak 2½ rods wide and consisting of 7 rows of trees, the following arrangement may be suggested: The three rows in the middle of the belt should be of blue gum (*Eucalyptus globulus*), the next row toward the outside on each side should be of Monterey pine (*Pinus radiata*), and the two rows occupying the two edges of the belt should be of Monterey cypress (*Cupressus macrocarpa*). This same arrangement may be used on a belt 5 rods wide by doubling the number of rows of pine and cypress and increasing the gum to five rows. In order to construct a windbreak in California that will be perfectly effective, the belts should be placed on all four sides of the area which is to

be protected. This is illustrated by the farmstead on the northwest quarter of the section shown in figure 15.

The belts advised in the model plan are of sufficient width to produce all the timber that will be needed on a farm of 160 acres, while the fields are sufficiently narrow to be protected from winds by the single lines of trees occupying the fence rows. Experiments have demonstrated that a windbreak, on level land, will be effective for a distance of at least ten times its height. For perfect protection on the model farms herein described, the trees in the windbreak must reach a height of at least 50 feet.

An objection to growing trees along fence lines has been made by farmers on the ground that such trees steal the soil nourishment from the crops which are on the edges of the fields. It is true that healthy, vigorous trees make great demands on the soil moisture in their immediate vicinity, but wherever their influence is felt as windbreaks they conserve enough moisture, by preventing rapid evaporation, to more than pay for all that they use. By planting a deep-rooted crop like alfalfa under the shade of the fence-line trees, good returns from the land may be secured in spite of the fact that the trees absorb a part of its moisture. It is a great mistake to begrudge a useful tree the space it occupies, and particularly so in the naturally treeless prairies of the Middle West.

SPECIAL ADVANTAGES OF FOREST PLANTING ABOUT THE FARMSTEAD.

On rare occasions it is found to be impracticable to concentrate the different elements of the farmstead in one place. (See fig. 16.) In the great majority of cases, however, it is both practicable and economical to have a farmstead, and the choice of its site is of the first importance to the landowner.

If the farmsteads of several adjoining sections were laid out in accordance with the plan herein suggested, four farmhouses would be grouped at each crossroads corner, bringing neighbors together in a little settlement. The position at the crossroads is also likely to facilitate the reaching of church, school, and town. An argument against such an arrangement is the possibility of its leading to neighborhood quarrels.

In many cases, however, uniformity of soil does not exist. The farmstead must then be located with reference to the adaptability of the soil to the forest growth, since a farmstead without trees for shade and shelter is not worthy of the name. The forest planter, therefore, is often the one to determine the location of a permanent site for the farmhouse, and he may also lay out at least the plan of the farmstead itself.

Figure 16, representing the farmstead located on the southeast quarter of the section sketched in figure 15, has been prepared to show how forest planting may be made to help every one of the different parts that go to make up the farmstead. Windbreak belts, 5 rods wide, are located on the north, west, and south sides of the farmstead. Open spaces varying from 72 to 96 feet in width have been provided to the north and west of the buildings and orchards, to act as snow traps to

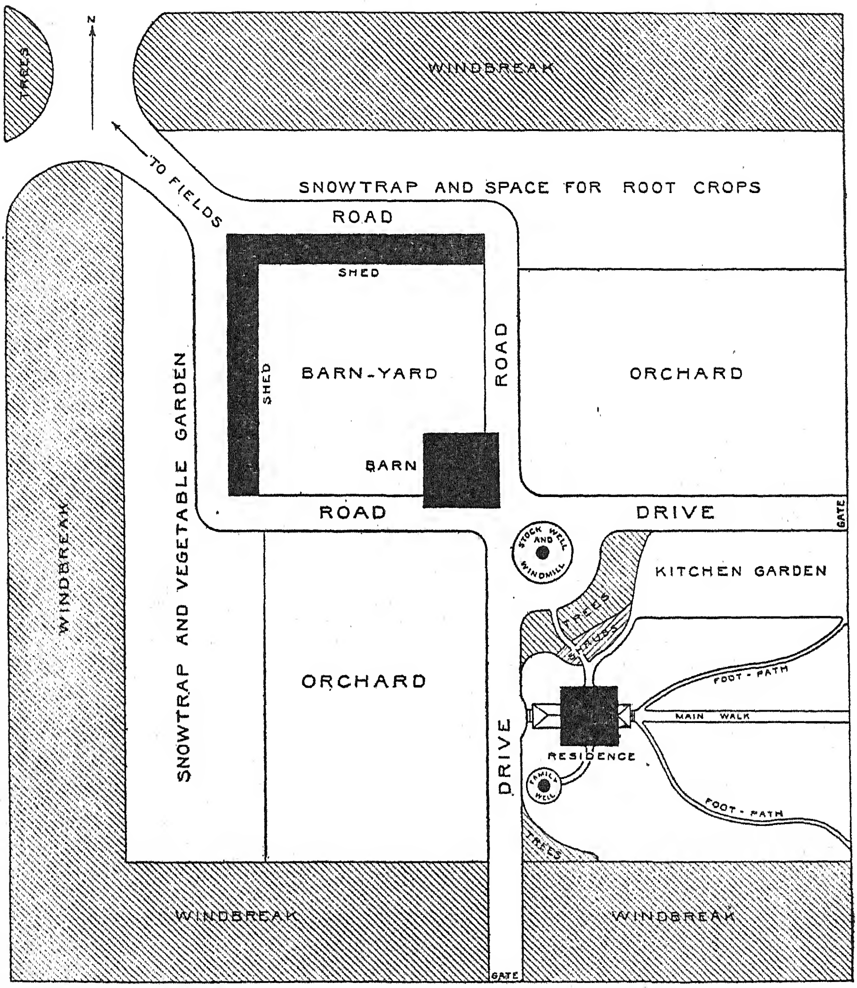


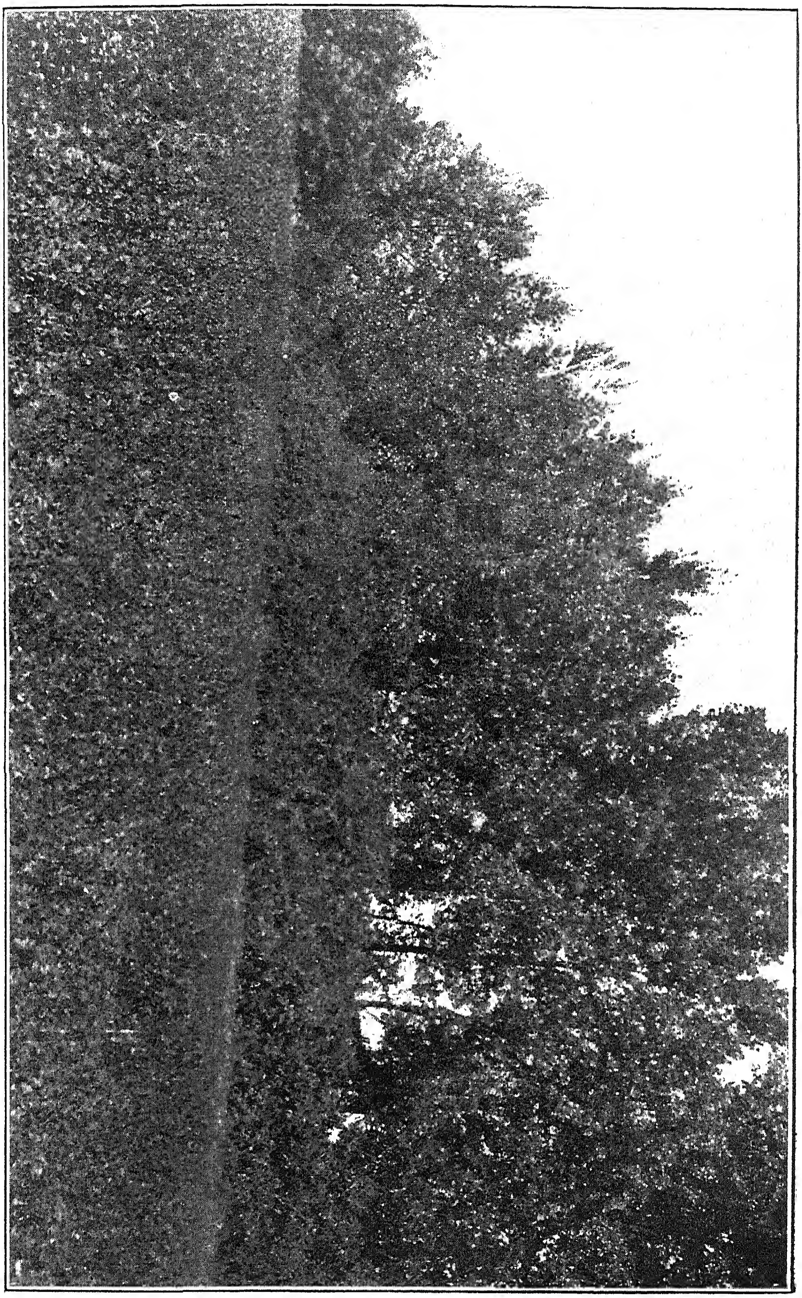
FIG. 16.—Plan of a farmstead, situated at the southeast corner of a prairie farm, arranged to afford windbreak protection to all the elements of the rural home.

catch the drifts during winter storms. Every farmer is familiar with the fact that a hedge or belt of trees on the north side of an east-and-west road will cause the road to be filled with snow during winter, when the wind comes from the north. The open space on the farmstead will in the same way trap the snow, and will consequently

prevent any drifts from forming near the barn or residence, or in the orchards. These open spaces may be utilized for garden vegetables, sugar beets, and other annual feed crops, the accumulation of winter snows serving as an annual irrigation to store up large quantities of soil moisture for the garden, and making the land particularly well adapted to this purpose. The trees on the edges of these spaces will, for the same reason, grow very vigorously.

In this plan the convenience, health, and comfort of the tenants of the farmhouse have all been considered in the location of both barn and residence. The grouping of the trees in the background of the lawn has been made with reference to adornment, but without an attempt to enter into the details of landscape gardening. The plan leaves the lawn in such a shape, however, that the landscape gardener may have full scope for the display of his talents. A plan including, as this one does, complete protection from the hot winds of summer and the cold storms of winter will add greatly to the intrinsic worth of any farm located in the prairie States. If the farmer is engaged in the production of beef and pork, the protection of the barnyard and feedlots will economize the feed consumed by the fattening animals, for it takes more grain to produce a pound of flesh upon animals exposed to the cold north winds of winter than upon stock protected from blizzards. Thus a windbreak takes the place of grain in maintaining the heat of the animal during cold weather. On the other hand, it will add to the farmer's bank account during the summer, for it will afford shade and protection to fattening animals, which lose flesh in very hot weather.

Windbreak belts in connection with a farmstead form an asset that is none the less real because the actual money value may not easily be determined. The protection to an orchard afforded by forest trees is valuable, since late frosts are not likely to blight the fruit blossoms of a protected orchard. Forest belts on the south and west sides of the farmstead give ample protection against the parching blasts from the southwest—the hot winds of summer, which are destructive to fruit in many parts of the country. It is to be understood, however, that the forest plantations herein recommended are also to be utilized for the production of the needed timber supplies on the farm. By judiciously thinning the plantations, 20 acres of planted forest will furnish all the fuel needed on a farm of 160 acres, besides producing lumber for the renewal of the farm buildings. Many Kansas and Nebraska farmers have in twenty years grown cottonwood trees large enough for sawlogs. Mr. W. D. Rippey, of Severance, Kans., cut 200,000 feet of cottonwood lumber a few years ago from trees of his own planting. Mr. Rippey's plantations were on uplands where the soil is not particularly well adapted to the growth of cottonwood, and, when lumbered, were but little more than a quarter of a century old.



WINDBREAK OF COTTONWOOD TREES AND PLUM BUSHES NEAR LARIMORE, N. DAK.

[Alfalfa field in the foreground located on the lee side of the forest plantation.]

Plate XXIII represents a scene on the farm of Mr. T. F. Eastgate, near Larimore, N. Dak., in the Red River Valley. A belt of planted cottonwood trees supplemented by a dense undergrowth of wild plum bushes acts as a windbreak and snow catcher, causing a snowdrift to form in winter over the open field shown in the foreground, which is devoted to alfalfa. In the summer of 1904 Mr. Eastgate harvested alfalfa hay from this field at the rate of more than 5 tons per acre.

Besides serving as a windbreak and snow catcher, thus making the growth of alfalfa possible on this farm, the forest plantation has produced cordwood during its twenty-one years of life at the rate of 4.74 cords per acre per annum.

The successful growth of alfalfa on 10 per cent of the area of this region would double the earning power of every acre of land in the Red River Valley; and, since the thermometer here sometimes falls as low as 50° below zero, it is possible to grow this extremely valuable forage only by utilizing some contrivance like Mr. Eastgate's windbreak, to catch the snowdrifts and form during the winter a protecting blanket over the plants.

CONCLUSION.

Forestry is but a branch of the great industry of agriculture, but it can give important aid to the farmer in getting sustenance for the human race from the soil. It has been shown that where forest planting is desirable, the planting plan is of fundamental importance to the management of the farm which is concerned. The location and cultivation of these forests may either make them peculiarly advantageous or cause them to become a detriment to the economical management of the farm.

The planting plans which have been set forth in the preceding pages are not regarded as perfect, but are given as suggestions of what may be done to make farm forest planting serviceable. They are based on considerable practical experience, and it is believed that they demonstrate beyond a doubt how far superior is a well-considered, systematic method of handling the problems of farm forestry to the haphazard, careless methods so often practiced in the past.

Farmers are now receiving instructions from the Department of Agriculture both for the establishment of forest plantations and for the inauguration of cropping systems, but it seldom happens that the same farmer receives instruction in both matters at the same time. The intimate relations existing between farm management and forest planting are so patent and their importance is so great that the two should go hand in hand. It is to be hoped that as the practice of scientific agriculture spreads, model farms may be laid out in all parts of the United States, on which practicable plans for forest planting

may be demonstrated and the best methods of planning the various parts of a farm so as to make provision for an economical and practicable system of crop rotation may be illustrated. Farmers, in order to get the services of Government experts in planning both forest plantations and systems of farm management, should make application for instructions both to the Bureau of Plant Industry and to the Bureau of Forestry.

AGRICULTURAL DEVELOPMENT IN ARGENTINA.

By Frank W. Bicknell,
Special Agent and Agricultural Explorer.

ARGENTINA AS AN AGRICULTURAL COUNTRY.

The Argentine Republic is one of our strongest competitors in the food markets of the world. In many respects it resembles the United States, being in nearly the same zone, on the other side of the equator, and having a large, fertile, level country, admirably adapted to agriculture and stock raising. Almost everything that can be raised in the United States can be raised more cheaply and equally well in Argentina. The country has a total area of 1,135,840 English square miles, equal to all the United States east of the Mississippi, with both the Dakotas, Minnesota, and Iowa added. About 25,000,000 acres are under cultivation, nearly half of which is in wheat. With the wheat she raises, Argentina can supply bread for her own 5,000,000 people and for 16,000,000 to 22,000,000 persons in other countries, calculated on the United States basis of $4\frac{2}{3}$ bushels per capita. The mild climate of the country gives farmers and stock raisers many advantages, for in the farming country the temperature rarely falls much below the freezing point, and grass grows the year round. The country extends through 34 degrees of latitude, or about 2,300 miles, from north to south, while the limits of the United States cover only about 24 degrees, or 700 miles less. The northern boundary of Argentina is 200 miles nearer the equator than the most southerly point of Florida, and the southern boundary of continental Argentina is 400 miles nearer the south pole than the United States (excepting Alaska) is to the north pole. The country is 800 miles wide at the widest point and tapers at the south to the narrow point of Patagonia, as it used to be called.

It is worth while for the farmers of North America to know something of the farmers of South America; what they produce and how they do it; what their natural advantages and disadvantages are; how their produce is marketed; how it is received and what the returns are to the producers; what the possibilities and probabilities of these new food producers are, and what, if any, are the opportunities to be found there by outsiders. In a residence of about eighteen months in

Argentina, while engaged in making investigations for the Department of Agriculture, the writer had an opportunity to see how agriculture and stock raising are carried on in nearly every part of that country.[a]

AGRICULTURAL CONDITIONS IMPROVING.

Nearly everything that has been done in Argentina thus far has been experimental. The tendency of the average Argentine farmer has not been favorable to progress. Years ago most of the valuable land of the country was parceled out in enormous tracts and either given away or sold for a trifle, without any obligation on the part of the owners to improve the land or open it for settlement. The small farmer was not encouraged, and large owners of land, as a rule, did not want it settled; they preferred to hold it, and were satisfied with a small revenue per acre, because they had so much. Immigration came chiefly from southern Europe—much the larger part of it from Italy. These immigrants were almost wholly ignorant of agriculture, and lacked the capacity or ambition to learn. Most of them did not want to own land, but were merely renters, getting all they could from one piece and going on to another, living for the most part wretched lives, getting small profits, and suffering many losses, owing to their ignorance and unwillingness to adopt improved methods. The influence of English and North American ideas has nevertheless been felt in the country, and most of the leading estancieros, or ranchmen, interested in cattle breeding especially, are now very ambitious to make the best use of their great opportunities. (Pl. XXIV, fig. 1.) They are not only improving the grade of their stock, but they are studying, with a view to making better use of their land, and we may expect them very soon to be practicing diversified farming more or less as it is done in the United States. One of their greatest mistakes has been that each man has gone in for but one thing—either the raising of sheep, cattle, or grain.

The climatic advantages of Argentina are so great that farmers there will probably always be able to produce live stock and grain cheaper than these can be produced in the United States. The farming land is rich and widely extended. There is no winter to contend with. Stock never requires shelter, and seldom dry feed for winter,

[a] Those desiring more detailed information about agriculture and stock raising in Argentina should consult the bulletins prepared by the writer of this article, and published by the Department of Agriculture, as follows:

The Animal Industry of Argentina, Bulletin No. 48, Bureau of Animal Industry; Indian Corn in Argentina, Production and Export, Report No. 75; Alfalfa and Beef Production in Argentina, Report No. 77; Wheat Production and Farm Life in Argentina, Bulletin No. 27, Bureau of Statistics.

except for fattening steers, and sometimes in dry seasons a little hay is used. Some advantage lies in the fact that the seasons are just the opposite of those in the United States.

While primitive, wasteful, and vicious methods (or lack of methods) prevail in all parts of the country to some extent, and scientific progress seems to have missed some sections altogether, the signs of progress, ambition, and improvement are everywhere to be seen in the better parts of the country. Argentina naturally began to improve first in the direction of her greatest interest—cattle and sheep raising. More than fifty years ago Leonardo Pereyra began to import Shorthorns from England for his ranch, near the city of Buenos Aires, and now it is estimated that three-fourths of the 25,000,000 to 28,000,000 of cattle in the country have more or less Shorthorn blood, which is the predominating breed there. The demand for the best breeding stock is one of the plainest indications of the desire to excel and of the realization that a well-bred animal pays a larger percentage of profit on the investment than a "scrub."

THE LIVE-STOCK BUSINESS.

There is no probability that Argentine cattle or sheep will be admitted to the English ports alive for a good many years, because of the existence of foot-and-mouth disease in Argentina. A fine business had been established in sending both sheep and cattle from the port of Buenos Aires when the disease made its appearance in the country in its severest form, causing the death of many thousand cattle. The English ports were closed to Argentine live animals and remained so until February, 1903, when the Argentine Government succeeded in persuading the British Board of Agriculture that the disease had entirely disappeared. On the promise of the enforcement of the most rigid sanitary laws to prevent the importation of the disease, and especially to prevent the sending of it to England if it should appear, the shipment of live animals to English ports was resumed. The requirements upon arrival in England were about the same as those imposed upon cattle from the United States. The business took on a great boom. The country was drained of cattle and sheep, and buyers do not seem to have made judicious selections, for some of them realized very poor prices. The facilities for shipping were wholly inadequate, and losses on the voyage were as high as 10, 15, and even 20 per cent, the latter in a few cases. Coming in competition with the corn-fed steers of the United States, the Argentine steers, bought at prices very high for that country, brought the shippers very disappointing returns, more often losses than profits. In this period of extreme stimulation steers sold in Argentina for $37 to $54, the latter and a few dollars less

being the price for the best three to three-and-a-half year old animals suitable for export. Many were bought at lower prices and sent to England, but these turned out worse than the higher priced animals; all of them, without exception, were either grass or alfalfa fed exclusively. None had been taught to eat grain, and so they lost weight on shipboard. The ocean freights varied from \$17 to \$22, and the sales were from \$58 to \$111, the latter a very exceptional figure.

But the business did not last long. In May, 1903, when the Argentines were just learning what they must do to succeed in the English live-stock market, the foot-and-mouth disease broke out again in a milder form, and in a few months it spread generally over the country. The Argentine Government closed its own ports to the exportation of live stock and set about trying to control the disease. The best information obtainable is that it went pretty generally over the country, especially in the central and northern parts, but did not cause the damage that the previous outbreak did. Recently the Argentine Government has been trying again to secure the reopening of the English ports to Argentine live stock, but without success. It is even said that if England continues to refuse admittance to the steers and wethers of Argentina, the latter will admit the breeding stock of France, Belgium, Germany, and other countries of Continental Europe, which has been excluded for several years because of the existence of disease in those countries and to satisfy English demands. As long as Argentina admitted cattle or sheep from Europe, England would not listen to her request for admission of live stock. There does not seem to be, however, any probability that England will reopen her ports to Argentine live stock, on account of the fear of bringing foot-and-mouth disease into England.

HIGH PRICES FOR BREEDING STOCK.

Argentina is the best market English breeders have for the sale of their pure-bred stock, and they will make every effort to hold it. Argentine breeders and beef producers have learned one lesson thoroughly, and are now learning another. The first is that it pays to produce a well-bred steer (Pl. XXIV, fig. 1) rather than a scrub; the other is that corn-finished beef is better than grass or alfalfa fed beef, and that such animals will travel better and bring a better price in any market. The first lesson has been accepted by all the leading cattlemen in the country, and is only disputed by the old-timers in the remote districts, who continue, from lack of ambition or knowledge, to breed the old, thin, small "criolla" or native cattle. The number and importance of cattlemen who are content with this kind of animals is very rapidly decreasing. The extraordinary demand for pure-bred stock is shown by the enormous prices paid in the sales. In spite of the fact that

FIG. 1.—SHORTHORNS AT THE ESTANCIA SAN JUAN, ARGENTINA.

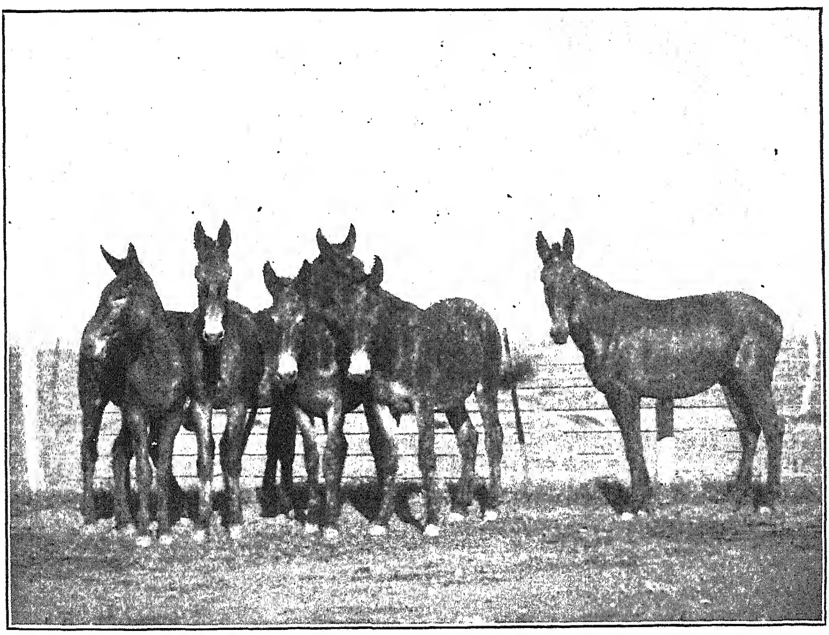


FIG. 2.—SOME BIG MULES, SOLD FOR $66 EACH.

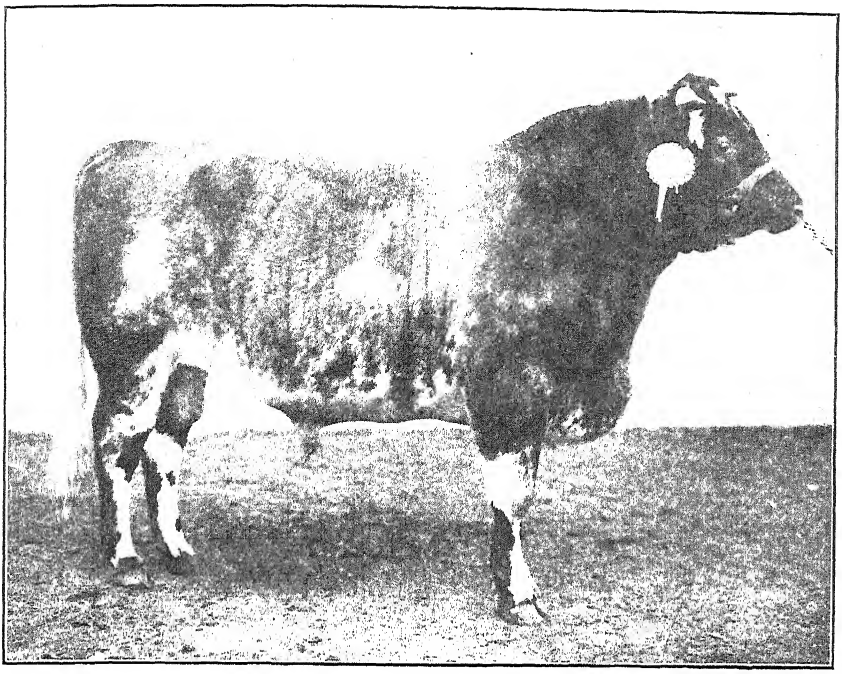


FIG. 1.—DURHAM BULL OXFORD BARON.

[No. 0150 (H. B. A. 6443); age, 1 year 11 months and 25 days, weight, 1,991 pounds; sold for $21,000 Argentine.]

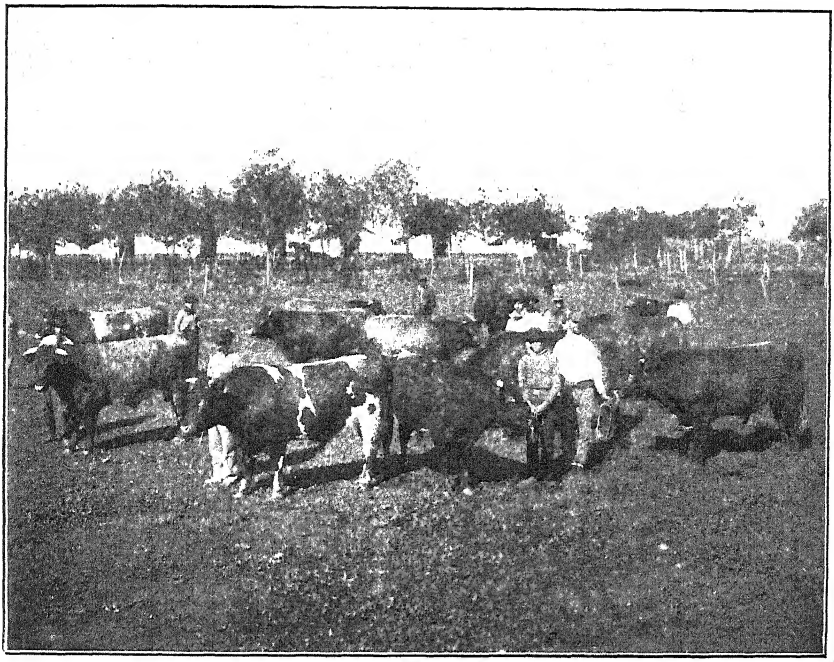


FIG. 2.—YOUNG DURHAM BULLS.

Argentine beef producers must sell their product to the freezing or chilling plants almost exclusively, the prices paid for breeding stock in the annual national exposition auction sales in September, 1904, were higher than ever before, and more animals were sold. Two Shorthorn bulls bred in the country were sold for $9,240 each, and one imported from England brought $13,640, the highest price yet paid in Argentina for a bull. During the past year many bulls, both imported and of domestic breeding, have been sold in Buenos Aires at prices ranging from $2,000 to $13,000, and probably at least 50 for prices above $5,000. Hundreds have brought more than $2,000. In the annual sales referred to 160 grade bulls were sold at prices averaging better than $500 each. All of these were Shorthorns. (Pl. XXV.) These high prices indicate fairly the intense desire of Argentine stockmen to improve their cattle. The Herefords and Polled Angus are not yet so popular in Argentina, as was evidenced by the lower prices. The top price paid for a Hereford was only $1,200.

The total value of live stock imported into Argentina in 1903 was $693,120, an increase of about one-third over the previous year. The increase the first six months of 1904 has been much greater.

LEARNING THE VALUE OF CORN FEEDING.

The Argentine cattlemen, as already stated, have begun to learn that it pays to feed cattle corn before sending them to market. For a long time they have been reluctant to admit that their grass and alfalfa fed cattle did not make beef as good in every way as the corn-fed steers of the United States. All those who shipped cattle from Buenos Aires to the English market during the few months of 1903 when it was permitted found unmistakable proof that the corn finish of three to six months was an absolute requisite for the production of the best beef. More attention is now being paid to the raising of Indian corn in Argentina. Conditions are very favorable for the crop, and it is sure to be used more for feeding. One of the leading English ranchmen of the Province of Buenos Aires, Mr. Glynne Williams, spent some time in the United States during the summer and fall of 1904, studying the best methods of corn production, with the intention of raising corn for his cattle and sending them to market in condition to produce chilled beef equal to any that is offered in the English market. Others are also planning to feed corn as a finishing touch to their best steers, believing that, with the low cost of producing the corn, it will bring enough more for the steers to make it pay. This will come about slowly, however.

During the first eight months of 1904, 3,333 cattle and 12,073 sheep were shipped alive from Argentina. The cattle nearly all went to Brazil, with a few to South Africa and Spain. The sheep all went to

Belgium, except a few to Brazil and Spain. Sanitary objections have been made against Argentine meat products in Austria, where a good trade was being developed. The South African trade has fallen off so that it amounts to very little, except in horses and mules—3,867 horses, 5,335 mules, and 2,003 donkeys being exported in eight months, most of them going to South Africa. (Pl. XXIV, fig. 2.)

THE FROZEN-MEAT TRADE.

Argentine ranchmen have settled down to the conclusion that they must rely upon the frozen and chilled meat concerns, selling almost exclusively in the English market, as the outlet for their beef and mutton. Exporting chilled meat and even frozen meat at the good prices of 1903-4 is more profitable than shipping the live animals. The price of Argentine frozen beef of the best quality in the Smithfield market the past year has been 3¼ pence (6½ cents) per pound, and frozen mutton 3¾ pence (7½ cents) for frozen mutton carcasses under 50 pounds; heavier carcasses brought 2 cents a pound less. Chilled beef brought still better prices. So it is unlikely that Argentine steers would be exported in large quantities even in the improbable event of the reopening of the English ports.

During the year 1903, 3,381,600 frozen wethers were exported, all to England except 250,860, which went to South Africa. In the same year the exports of frozen and chilled beef, mostly frozen, were 996,023 quarters, all to England except 224,999 to South Africa. For the nine months January to September, 1904, the exports were 2,894,369 mutton carcasses and 862,938 quarters of beef, a considerable increase over the same period in 1903. For four years previous to 1903 the exports of mutton and beef were as follows:

Exports of beef and mutton from Argentina, 1899–1902.

Year.	Quarters of beef.	Carcasses of mutton.
1899	113,431	2,485,949
1900	265,965	2,385,214
1901	498,375	2,722,727
1902	830,213	3,429,222

At present five freezing plants are at work near the city of Buenos Aires, making the shipments referred to in these statistics. These properties are given a valuation of $5,600,000 by the Government statistics, and their capitalization is over $53,000,000. There is one other, at Bahia Blanca, the principal seaport in the southern part of the Province of Buenos Aires, not included in the statistics of 1904. It

is less than a year old. Several other freezing and chilling plants are in the course of construction, though the business has not paid the past two years as it did at first, when there were only two plants and dividends of 40 per cent were declared. In October, 1904, the best prices paid by these "frigorificos," as the freezing plants are called, were $35 to $40 for the best young steers on the ranch. Lincoln wethers brought $4 to $5.50, Rambouillets $4.20 to $4.90, and lambs $2.60 to $3.50. These were for the best fat animals, fit for freezing. The ordinary ones sold for much less. These prices are above the average for the year, because the time for shearing was approaching.

Only one establishment is sending chilled beef to England, and very good success is reported. We may expect that more chilled beef will be sent in the future in the place of so much frozen meat. The latter has not always met with the demand that was anticipated when the additional "frigorificos" were built. Frozen meat appeals only to a cheaper class of trade, and the English market, it is said, has often been oversupplied with it. The Argentines, therefore, intend to send to England chilled corn-fed beef. It will be several years before the volume of such shipments will be great enough to be seriously felt, but the time is surely coming when Argentine chilled beef will be an important factor in the English market, and there is no reason to doubt its being first-class. The disadvantage of the longer voyage will be more than overcome by the saving in cost of production in Argentina. Labor, land, and feed are all cheaper than in those parts of the United States where cattle are fattened for export.

NUMBER OF ANIMALS IN ARGENTINA.

No census of the live stock of Argentina has been attempted since 1895, and it is admitted that the census then taken is wholly unreliable. The best estimates claim from 25,000,000 to 28,000,000 head of cattle in the country. The first figure is probably more nearly correct. The number of sheep is estimated at from 85,000,000 to 120,000,000. It is still more difficult to arrive at a definite idea in regard to the number of sheep, because they are more scattered and less care is taken in enumerating them. Probably the number is between 90,000,000 and 100,000,000. The wool shipments of Argentina have not varied much in the past nine years, but last year (1903–4) was the lowest of any in that period. The exports were about 181,000 tons. In 1895–96 the exports were 231,000 tons. The tendency in sheep raising is now to raise more of the Merino type, instead of the long-wooled, big-carcassed Lincolns, which have been the dominating breed for twenty years. (Pl. XXVI.) Rambouillets are bringing a much higher price

now, as the English market calls for the small, fine-grained carcass, not over 50 pounds, and the finer wool is in much better demand.

THE DAIRY INDUSTRY.

The dairy industry is developing into one of the chief interests of Argentina. A few years ago little or no attention was paid to it. During the year 1903, 6,875 tons of butter were exported from Argentina, at an average price of 17½ cents per pound. The exportation of 1904 will show a very large increase over this amount. In 1898 only 1,021 tons were exported. Argentine butter is of an excellent quality and is successfully competing in English markets with the best butter of other countries, bringing almost as good a price as Danish butter. It is shipped in 1 and 2 pound packages, packed in boxes holding 56 pounds. The system now in vogue is the shipment of cream from small gathering stations all over the country to a few large creameries, chiefly the one in Buenos Aires. This is a cooperative concern on a very large scale, and it has been successful and profitable.

BENEFITS FROM ALFALFA.

Following the improvement in breeding came the betterment of the pastures. The introduction of alfalfa has redeemed hundreds of thousands of acres of land hitherto of no use; the carrying capacity of thinly grassed rough land has been increased five, ten, and even fifteen fold by seeding the land to alfalfa. The foundation of the Argentine animal industry is built upon the wonderful capacity of this plant to reach deep down into the semi-arid land and bring the moisture to the surface. It has caused the development of a vast area of waste land in the western and northern parts of the country without irrigation. Cattle are sent from the breeding ranches to these outlying alfalfa pastures to be fattened. The carrying capacity of Argentine alfalfa is, in round numbers, from three-fifths to one animal per acre, while the usual average carrying capacity of the native grasses is one animal to 8⅓ acres. Some of the rich native pastures of the Province of Buenos Aires will carry one animal for every 2 acres; and, as there are both winter and summer grasses, this makes very good feed, except in dry seasons. Nothing resists the drought so well as alfalfa. The favorite method for securing alfalfa pasture is to plant the land with wheat. The ranchman rents his land to farmers, who raise two crops of wheat, paying him a good rental, and the third year sow alfalfa with the wheat, the owner paying only for the seed. In this way he gets his land into alfalfa at very small cost, and the results, while perhaps not quite so good as may be secured by sowing alfalfa alone, are generally satisfactory, because the ranchman of limited capital is thus enabled to secure a large amount of alfalfa pasture in a short time.

The life of Argentine alfalfa varies according to the use that is made of it and the location. The best success has been had in the western part of the Province of Buenos Aires, in San Luis, Cordoba, and Sante Fe, where the soil is light. The strong native grasses overcome alfalfa in the rich land of the Province of Buenos Aires. In the more favorable localities alfalfa, with ordinary care, lasts about fifteen years, although if it is fed short and not cut it may be run out in five years. In less favorable localities five to ten years is its average life, and it must be carefully treated, alternately fed and cut.

Alfalfa hay is very extensively used and is exported in increasing quantity, amounting now to over 100,000 tons per year. Four to eight cuttings per year are made, varying from four in the least productive regions to eight in the richest alfalfa fields of the north and northwest used exclusively for hay. Five to six cuttings is the average in good seasons in the best localities; about a ton per acre is the average for each cutting. The producers get from $8 to $10 per ton, and in the city of Buenos Aires the price is often much higher. The export price during the past twelve years has averaged from $8 to $12 per ton. The principal foreign consumers of Argentine alfalfa are Brazil, England, and South Africa.

The chief value of alfalfa in Argentina is that it brings steers to market a year sooner than could be done with the native grasses. This fact, with its drought-resisting strength, makes alfalfa absolutely necessary to Argentine ranchmen, and they are putting in as much of it as they can.

WHEAT PRODUCTION.

Aside from the production of cattle, by which Argentina first attracted the attention of the world, the country is known as a wheat grower, and will continue to increase in importance in this direction. The extraordinary gain made during the year 1903–4 in crop raising as against animal production was not due to any unnatural or phenomenal causes. Exports of farm products during the first six months of 1904 increased more than a third over the same period in 1903, which was considered a very good year. At the same time the exports of animal products fell off about 8 per cent. The total wheat export of Argentina up to the 1st of October, 1904, was 100,000,000 bushels, while the total for the year 1903 was only 75,000,000, and for the preceding year only 23,690,070 bushels. The wheat area is rapidly extending to the west and southwest. The acreage estimated by the Argentine Department of Agriculture for the past season was 9,275,178, and the estimated production 124,160,636 bushels. This is chiefly in the Provinces of Buenos Aires, Santa Fe, and Cordoba, with smaller amounts in Entre Rios and in the Territory of the Pampa.

The extension of wheat growing in Argentina depends largely upon immigration. Men to till the soil is the greatest need the country has. The wheat area at present includes the southern third of the Provinces of Entre Rios, Santa Fe, and Cordoba; all the Province of Buenos Aires, except the eastern part, which is subject to overflow; the northwestern part of the Neuquen and the Pampa Territories, and the river valleys in the southern and colder regions of Chubut and Rio Negro. Sufficient experimenting has been done to make it reasonably well known where wheat will succeed and where it will not pay. It has been driven from the northern and warmer part of the country to the central and southerly part, where the temperature is lower. Only a small part of the available wheat area is used for that cereal. As fast as farmers can be found to do the work it will be extended.

Nothing but winter wheat is grown, and that largely of an Italian variety called Barletta. This variety is a semi-hard wheat, resembling our hard red, but not so hard. It has shown greater adaptability than any other variety, resisting drought and rust, giving better yields, and standing more abuse. It does not readily shell out, but stays in the head until the farmer gets ready to cut it. It is very heavy, weighing from 60 to 64 pounds per Winchester bushel, and often more. It contains a very high percentage of gluten; analysis has shown 17 per cent of gluten in Barletta wheat.

INCREASING IMPORTANCE OF FARMING.

Farming is making great gains in Argentina. It used to be rather looked down upon, and little was done to encourage it. The rich men who controlled the Government were nearly all engaged in the stock business. Their animals lived on grass and roamed over vast areas. The small farmer was not wanted. Now the land is more valuable and is being cut up more. Farming has become more profitable to land owners. The gain in crop raising is shown by the Argentine export statistics of the first six months of 1904, compared with the same period of 1903:

Exports of Argentine animal and plant products compared.

EXPORTS FOR THE FIRST SIX MONTHS OF 1903 AND 1904.

First six months of 1903:		First six months of 1904:	
Animal products	$65,584,432	Animal products	$60,188,501
Plant products	59,933,020	Plant products	80,644,366

EXPORTS FOR 1903.

Animal products:		Plant products:	
Per cent of whole	49.4	Per cent of whole	47.6
Value	$109,181,342	Value	$105,251,309
Increase over 1902	4,642,203	Increase over 1902	37,059,977

The total increase in exports of farm products in 1904 was much greater than in 1903.

FARMERS MOSTLY RENTERS.

The latest statistics show that only about one-third of the farmers are owners of lands they farm in Argentina, while in the United States the proportion is almost two-thirds. Especially in wheat raising the farmers are renters, raising wheat continuously as long as it will hold out, or as long as they are permitted to stay, when they move on to other land. They are mostly poor, living without comforts and working without intelligence. Having no interest in the country, they seek only to get all they can from the land, regardless of the effect of their ruinous operations. They are being employed profitably by many large ranchmen to convert their pastures into alfalfa, by raising wheat for two or three years prior to sowing the alfalfa. They generally do very poor work and their losses at harvest time are frequently heavy, because the grain is improperly stacked or is not sheltered after it is thrashed.

The roads are very poor and the expense of getting to market—both the hauling to the railway station and the freight from there to the seaboard—is very high. Freight rates in Argentina are more than twice as high as in the United States. Wheat is raised as far as 35 to 60 miles from the railway station. Thirty miles is considered about the limit for profitable production. The cost of hauling is from 4 to 12 cents per bushel, depending on the distance. The grain is all put in bags, holding not more than 70 kilos (154 pounds); the bags add further to the cost about 3.87 cents per bushel. The freight to the seaboard varies from 5 to 6 cents for distances less than 100 miles up to 10 and 13 cents for distances ranging from 200 to 350 miles. The average Argentine freight rate in 1901, according to Government statistics, was 1.6 cents per ton per mile, or more than double the freight rate in the United States, according to the report of the Interstate Commerce Commission. On most of the products in which the farmer is interested the rates in Argentina are much higher. The railways, of which there are about 11,000 miles, are nearly all owned by English capitalists, with Englishmen holding the important positions in the management and operation.

COST OF PRODUCING WHEAT.

It is impossible to state exactly the average cost of producing a bushel of wheat in Argentina, because so much of it is produced by family labor, and it is claimed that this is the only way the Argentine small farmer can make a profit. Producers on a large scale who have kept careful records have estimated the cost of production at from 40 to 56 cents per bushel. Estimates on producing an acre of wheat, furnished by three good authorities, ranged from $4.93 to $8.29, the latter being the estimate for producing by hired help on a large scale.

Prices of wheat in Argentina vary according to the distance from the market, and are of course subject to the influence of the supply from other quarters. In the past thirteen years the prices have varied from 47 to 91 cents per bushel. The price in Buenos Aires the past year has been from 75 to 88 cents.

YIELD OF WHEAT.

The wheat yield of Argentina varies greatly, because of the different climatic conditions and methods of cultivation. The southern part of the Province of Buenos Aires gives the best results, except a small area in the far south, in the valleys of the Chubut and Negro rivers. The statistics of the Argentine Department of Agriculture give this region an average yield of 38.84 bushels per acre for ten years ending 1901. In these statistics southern Buenos Aires is given 20.26 bushels per acre, the yield decreasing to the northward, until in the north and center of the Province of Santa Fe it is 10.63 bushels per acre, and often much less. The past two or three years have given better returns than this in the south, a yield of 18 to 20 bushels per acre having been secured by most of the farmers in the Province of Buenos Aires.

Facilities for marketing grain are poor, but are improving. Railway companies have been required to provide shelter in the stations for grain offered for shipment, because they are unable to handle it as fast as it is offered during the busy season. Some immense elevators have been constructed in the ports of Buenos Aires, Rosario, and Bahia Blanca. Most of these are owned by railway companies and operated in their interest at high charges.

MILLING.

Milling is not in the most prosperous condition in Argentina, but it is improving. It has been a failure in the interior, except for local trade. In the export cities of Buenos Aires and Rosario, reached by ocean-going ships via the Plate and Parana rivers, it is quite prosperous, and in the former city are some large modern mills. In 1903, 849,918 barrels of flour were exported, chiefly to Brazil, where Argentina is the chief competitor of the United States. The capacity of the mills has been increased, and the exportation of 1904 was larger than for preceding years. The flour produced by these mills is of excellent quality and the bread of Buenos Aires is very superior.

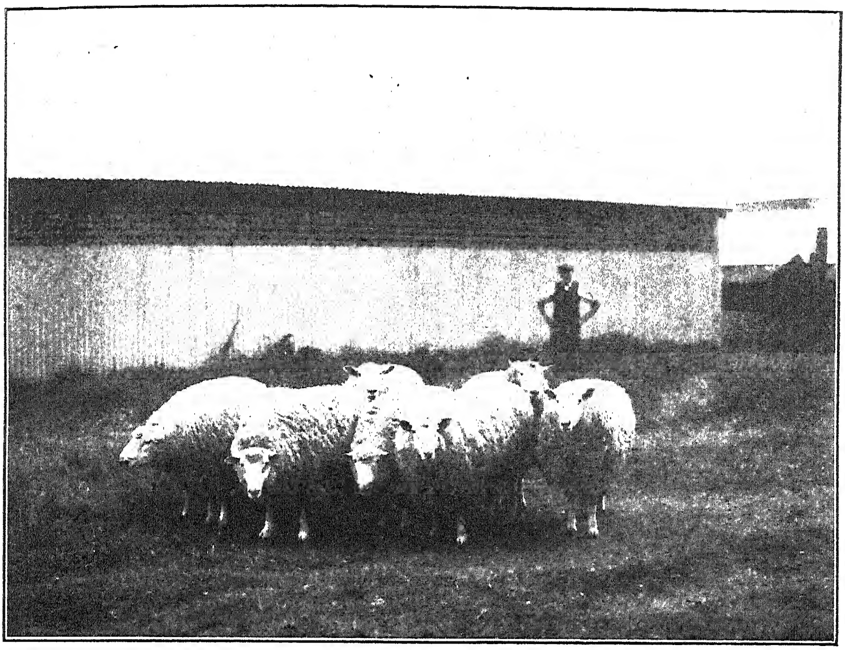


FIG. 1.—LINCOLN RAMS.

FIG. 2.—OXFORDSHIRE DOWNS.

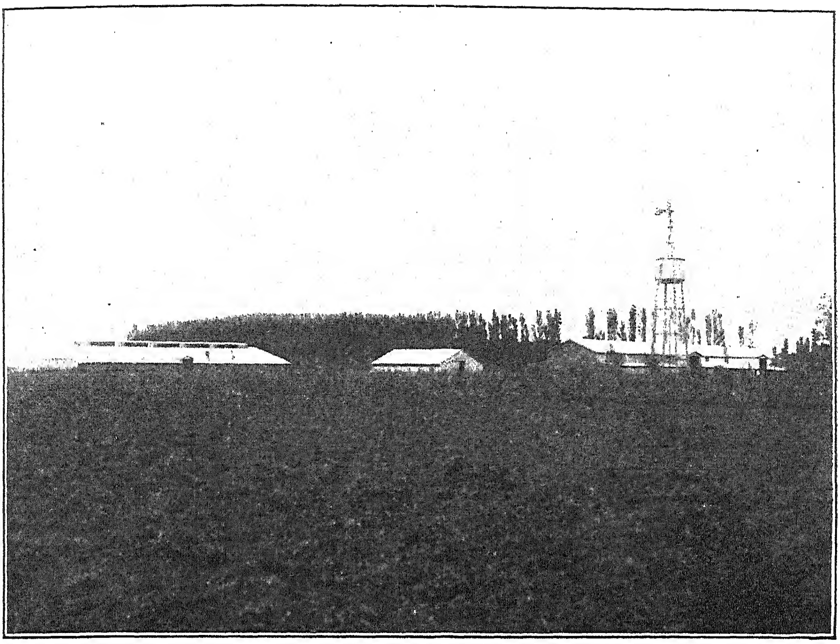


FIG. 1.—CATTLE SHEDS.

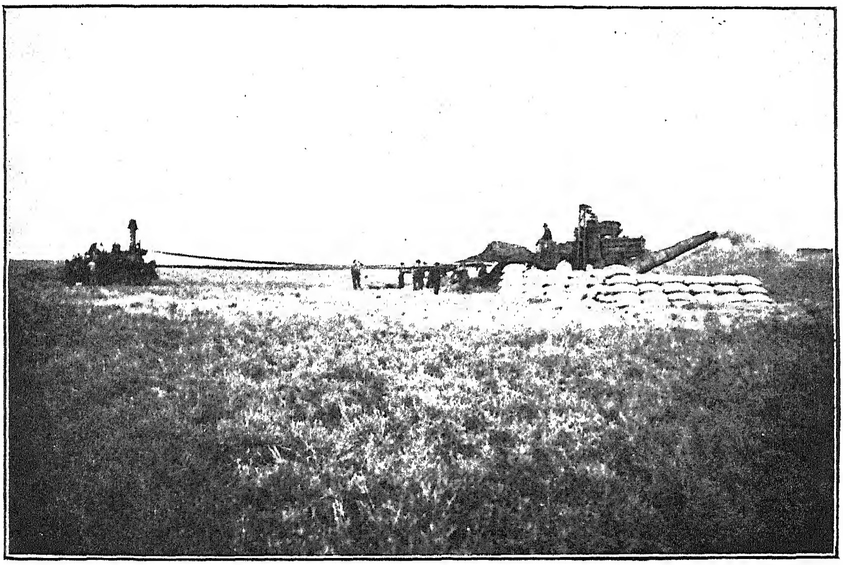


FIG. 2.—AN AMERICAN THRASHER AT WORK NEAR TRES ARROYAS, PROVINCE OF BUENOS AIRES, ARGENTINA.

INCREASING PRODUCTION OF CORN FOR FEED.

The next important forward step of the Argentine farmer will be that he will raise more corn in connection with his live stock and will finish his steers somewhat as they are finished in the United States—with a few months of corn feeding. (Plate XXVII, fig. 1.) The country is admirably suited to the production of Indian corn, which is now grown in enormous quantities in a large territory, but is chiefly exported. In 1903 Argentina exported 81,000,000 bushels. More than half the corn produced in the country is exported, while in the best corn States of the United States all but about 12 to 15 per cent remains in the county of its production. In years favorable to the production of corn two-thirds or more of the Argentine crop is exported. Farmers there are now beginning to learn that the most profitable way to sell their corn is to send it to market in the condensed form of beef or pork. They have done little or nothing in the direction of raising hogs, but interest in this profitable animal, which may be raised without trouble in Argentina, is awakened, and it will be only a matter of a few years until the country will produce a considerable amount of pork.

Argentine farmers never fear frosts for their corn. It may be planted any time from August to January, but is usually planted in October or November. Early planted corn is better, because it ripens and dries sooner. Harvest begins at the end of February. The greatest disadvantage suffered by the Argentine corn raiser is the fact that the gathering season is likely to be wet. There is no cold, dry weather to ripen and cure the corn. This adds greatly to the difficulties of marketing, and is one reason for the choice of variety. The most successful kind is the hard, slender-eared flint corn, known as "cuarenton" and "cincuentino," which takes its name from the fact that it takes from forty to fifty days to form ears. Ninety to 95 per cent of the corn in the country is of this yellow variety. It is too hard for animals to masticate without its being partly crushed, but it yields a high percentage of alcohol and brings a good price in the European market, besides resisting the dampness of the ocean voyage better than soft corn, because it does not so readily absorb moisture.

Notwithstanding the inferior methods of agriculture followed by the corn-raising farmers of Argentina, they have secured astonishing yields. These vary greatly in different localities and are the result of better or worse cultivation. The average crop in the corn district is better than 40 bushels per acre, but this is not considered a satisfactory crop by a good farmer. In the rich alluvial lands of Buenos Aires and southern Santa Fe the yields run from 60 to 110 bushels per acre, and good farmers expect 70 to 80 bushels. Very little corn in the

country is properly planted or cultivated; the rows are too close—generally not more than 22 to 24 inches—and the seed is drilled in, hardly ever planted on "the checker-board plan of North America," as they call it there. Better farmers, however, are learning that the method of the United States is the right one, and several hundred North American corn planters and cultivators have been sold and are in profitable use. It is hard to convince the Argentine farmers that by planting half as much seed they will get twice as much crop, but those who have tried it know that such will be the result.

Experiments have been made with the North American dent corn, and while they have not always been satisfactory the most intelligent experimenters believe that some of our varieties more suitable for feeding will be adaptable to their use.

Many of the progressive ranchmen are already planning to combine the raising of cattle, corn, and hogs, as in the United States. With cheap land, cheap labor, and favorable climate they expect to be able to duplicate the food products of the United States at a much lower cost, except for transportation.

At present the corn area of Argentina extends from the city of Buenos Aires about 250 miles to the south, 300 to 400 miles to the southwest, 300 miles west, 350 to 400 miles northwest, and 350 to 400 miles north. Less than 5,000,000 acres were cultivated last season. This area is sure to be extended in every direction except to the west. Corn is now grown outside these districts, but not to any great extent. The warmer regions do not give good results and the cooler regions at the south have not been exploited. Corn raising in Argentina is mostly done in a much warmer climate than in the United States. Most of the crop is raised north of latitude 36° south, chiefly from 35° to 33° south, while the corn belt of the United States is in latitudes 38° to 42° north. In short, the Argentine corn district ends at a point 100 miles nearer the equator than that at which the United States corn region begins.

The price of corn in the Buenos Aires and Rosario markets has been from 35 to 40 cents a bushel the past year. This means that the farmer does not get over 20 to 30 cents. Yet, the crop has been profitable, especially near the seaboard, where the yield is best and the cost of getting to market lowest.

FLAX, FRUIT, COTTON, AND TOBACCO.

Other important Argentine products of which we are sure to hear more in the future are flax, fruit, cotton, and tobacco. The exports of flaxseed in 1903 were 23,118,773 bushels. Delicious fruits are

produced, including peaches, pears, grapes, figs, oranges, strawberries, cherries, apricots, etc., and, in the southwestern and colder regions, apples.

USE OF AGRICULTURAL IMPLEMENTS FROM THE UNITED STATES.

Agricultural implements from the United States are getting to be generally used in Argentina. Binders, headers, mowers, rakes, plows, harrows, thrashers, and engines (Pl. XXVII, fig. 2) are the principal items. In the year ending June 30, 1904, the United States sold to Argentina implements to the value of $3,996,476, an increase of more than $1,000,000 over the previous year.

DIFFICULTIES OF THE SMALL FARMER.

Land for agriculture has rapidly risen in value during the past three or four years, but may still be had for from $5 to $15 per acre, depending largely upon the distance from the railway station and from the seaboard. Good land within 4 to 8 miles of a railway station and 100 to 300 miles from the seaboard may be had for $10 to $15 per acre. It will be disappointing, however, to any North American small farmer who goes there alone. The country is no place for a poor man. The writer has had many inquiries from young men in the United States who thought Argentina was a good place to go to get a start. The conditions of labor are such that the start should be made under more democratic conditions. The line is drawn very sharply between the rich and the poor and the gap is very wide. The opportunities of the Western United States do not exist there. A North American farm hand would not submit to the treatment or the associations he would find in Argentina. Agriculture and stock raising, especially the latter, are conducted on a very large scale. The man of small capital has comparatively little chance. If an organization of farmers from the United States should go to Argentina and introduce improved methods, success would doubtless follow, if local conditions were studied and understood before investments were made. Great opportunities exist for profitable investment in the development of the resources of the country, but the greatest prudence must be exercised and care taken to know in advance how to avoid the difficulties that beset the stranger in a strange land.

Lands for agriculture rent for from 70 cents to $4 an acre, depending more upon accessibility to market than any other one item. Fertility is the next consideration, and improvements cut no figure, except that new land is preferred. The poor Italian or other immigrant from Europe comes to the country with nothing. He works a year or two as a laborer for small pay and very poor shelter and board,

until he has paid his debt to the man who advanced him money to come. He spends almost nothing. In two or three years after his arrival some landowner will give him land, seed, implements, and animals, even guaranteeing his little grocery account, to get him to work land for half the profits. His condition now improves, and in another two years he will be found paying cash rent. All members of the family, young and old, of both sexes, work very hard during the busy seasons; and they have no comforts, only bare necessities, and these far below the standard of the poorest North American farmer. An increasing number of them are buying land, and very slowly they are learning diversified farming, so that they may have something to do all the year round.

THE CASTOR OIL INDUSTRY.

By Charles M. Daugherty,
Of the Bureau of Statistics.

THE USES OF CASTOR OIL.

Castor oil is now extensively used in countries which manufacture large quantities of calicoes and colored cotton goods. The United Kingdom is the greatest European consumer, and of the other principal consuming countries the United States ranks easily among the first. As compared with the enormously increased consumption of other fixed or expressed oils, the use of castor oil in the United States is on a small scale; the annual consumption is measured by hundreds of thousands of gallons, where that of either cotton-seed oil or linseed oil amounts to tens of millions. However, the functions that castor oil performs in industry and in the arts are of great economic importance, as becomes apparent from a consideration of the varied uses to which its peculiar properties adapt it.

USE IN DYEING AND PRINTING COTTON GOODS.

Within comparatively recent years, that is, since aniline dyes have almost completely supplanted the mineral and vegetable dyes formerly used in coloring cotton textiles, an extensive demand for castor oil has sprung up in the industry of dyeing and printing cotton goods. Without presuming to invade the intricacies of the dyer's art wherein secret recipes for the composition of colors and their application to cloth are the property of each individual dyer, it may be said that the general principle underlying the utility of this oil in coloring processes is that the aniline and alizarine dyes are soluble in sulphurated castor oil; in other neutral fats and oils these dyes, with few exceptions, are in general insoluble. In certain processes of dyeing and printing, therefore, castor oil enjoys a practical monopoly over all other oils.

The popular red, formerly known as Adrianople red, but now commonly as Turkey red, famous for the permanency, intensity, and beauty of its color, owes its quality of exceptional fastness to castor oil. The coloring matter itself, alizarine, which was originally derived from the root of the madder plant, but is now almost wholly supplanted by an artificial dyestuff of the same name obtained from anthracene, a product of the distillation of coal tar, has, like many dyes, little affinity for cotton fiber. Applied directly to the cloth by ordinary methods it gives a color of little permanency. To fix this color there

is necessary the treatment of the cloth with some substance or agent which, having an affinity for both the cotton tissue and the coloring matter, alizarine, assists in effecting a chemical combination between them. The substance now almost exclusively used for this purpose is castor oil. Mixed with a small quantity of concentrated acid, which is then washed away by a solution of common salt, and soda or ammonia being added to saponify the fatty acids, there is produced from castor oil another oil which is perfectly soluble in water, a property especially desirable for the saturation of cotton cloth. The resultant oil is known by many names—sulphurated castor oil, soluble oil, sulforicinate, etc.—but from the use to which it is largely devoted, that of fixing alizarine dye upon cotton goods, it is generally known as alizarine-assistant, or Turkey-red oil. The economic value of this oil depends largely upon the fact that the specific red thus fixed by it upon cotton cloth is one of the most permanent colors known to the dyer's art. Soluble oil is also used as a substitute for the more expensive glycerine in the treatment of cotton cloth. It has an admirable effect upon starch mixtures, and imparts to the fabric a quality of softness, suppleness, and pliancy. Although no definite figures are extant as to the the quantity of castor oil annually consumed by the textile industry, the consensus of opinion among those best qualified to know is that a greater portion of the castor-oil output of the United States is utilized in the treatment of cotton goods than for any other single purpose.

USE FOR MEDICINAL PURPOSES.

Probably the next most important channel of consumption is the drug trade. In earlier days castor oil was best known as a medicine. The once universal disposition to regard it as a "sovereign remedy" is still among the early remembrances of living men. Not only was the customary maternal diagnosis of each childish ailment prone to result in a repulsive dose of castor oil, but even among hearty adults occasional self-prescribed doses of this so-called panacea were deemed necessary to the continuance of perfect health. Thus, two factors contributed to its consumption—its positive value as a medicine and its apparently harmless effect upon good health. In addition to its common use as a purgative, rheumatism, lumbago, skin affections, cramps, colds, and a host of other ills were popularly believed to yield to its curative properties; in fact, medicinal use was a highly important element in the castor-oil trade. Naturally, the marvelous advance that has been made in medical science in recent years has resulted in the widespread substitution for this once popular cure-all of less nauseating, if not more efficacious, drugs. As a general rule, physicians less frequently prescribe it. Modern preparation in capsules and compounds has, it is true, had a decided tendency everywhere to perpetuate its traditional uses as a self-prescribed remedy. In some rural communities, too,

especially among the colored population of the South, its medicinal virtues still retain much of their old-time popularity, and in some pharmaceutical compounds it is still a staple. In short, considerable quantities of the high grade of castor oil are still absorbed by the drug trade, although its value as a medicine has, on the whole, somewhat declined in public esteem, and there no longer exists for it so universal a demand as a "home remedy."

MISCELLANEOUS USES.

Castor oil has many other and varied uses, some of which are not common to the United States. Was the trite saying, "Every man to his taste," ever better exemplified than by the almost incredible custom, said to prevail in parts of China, of using castor oil as a cooking grease, as lard is used in America? A less surprising but, as judged by American standards, almost equally uncommon custom is the use of this oil in British India and in some other Oriental countries as an illuminant. In British India it is reputed, among other uses, to be extensively used as a lamp oil, and reports of no ancient date even refer to it as the illuminating agent in railway cars. Castor oil also has in some countries extensive uses as a lubricant. In Australia, which imported 769,392 gallons in 1898, the chief use is officially stated to be for this purpose, and the decline in imports in 1902 to less than 500,000 gallons is attributed to the substitution for this vegetable product of the mineral product, petroleum. It may also be noted that in the Cape of Good Hope, where the oil is probably largely used for the same purpose, 307,728 gallons were imported in 1902. To a limited extent this oil is used for lubricating purposes in the United States. As is well known, the mechanical function of lubricating oils is to form a coating or cushion between rotary surfaces, thus keeping them free from contact and preventing loss of power through friction. To this purpose castor oil, being heavy bodied, viscous, and nondrying, is in most cases well adapted. It is the heaviest of fatty oils, having a density of 0.96, and is particularly adapted to the oiling of fast-moving machinery because the heat generated keeps it in a liquid state. In the oiling of special kinds of machinery, carriage wheels, etc., it is still used to a small extent in the United States; but for general lubricating purposes the cheaper but lighter-bodied mineral oils, to which the required viscosity is frequently given by the admixture of resin, have almost completely supplanted this as well as other oils. The esteem in which castor oil was popularly held as a lubricant, however, is suggested by the fact that petroleum products adulterated with resin are in some instances now sold upon the markets under the designation of "machine castor oil." Castor oil also has properties that adapt it to use in the dressing of leather, and a demand for limited quantities exists in the United States, especially in country districts, for domestic

use in oiling and softening boots, shoes, and harness. Among minor uses may be mentioned its use in the manufacture of "sticky fly paper" and of the so-called "glycerine soap." For some of its varied uses it is apparent that the demand for castor oil in the United States has declined; for others, especially in recent years, it has increased. The resultant of these opposing forces, however, is that consumption as a whole is on the upward trend. Quantitatively, the consumptive demand for this product in the United States is now probably at its maximum up to this date, and absorbs in round numbers about 1,000,000 gallons annually.

THE MANUFACTURE OF CASTOR OIL.

The manufacture of castor oil in the United States is an economically important, but, as measured by the capital invested and labor employed, a small industry. As is true of most of the industries engaged in this country in the expression of oil from oleaginous seeds, however, the productive capacity is far in excess of the total demand for oil. Of the dozen castor-oil mills located in different sections of the United States, several have been practically idle for some years. The remaining mills, though constituting the so-called active branch of the industry, are operated with irregularity, or as the exigencies of the supply of castor beans and the demand for castor oil require. The present principal active centers of the industry are Jersey City, N. J., St. Louis, Mo., Kansas City, Mo., and Memphis, Tenn. A single mill is located in each of these centers, excepting that in St. Louis (including one mill in east St. Louis) there are three. The mill in Jersey City, containing six presses, the largest number in any mill in the United States, is advantageously situated for handling imported beans. The western mills, operating three or four presses each, were originally established for pressing the crop of the castor-bean belt of the United States. There are also two mills in Boston, Mass., one of which is operated in connection with an alizarine-assistant manufactory, one in Brooklyn, N. Y., and a mill in Grand Rapids, Mich., adjunct to the manufacture of sticky fly paper. Doubtless the productive capacity of the castor-oil mills of the United States is sufficient to supply double the country's requirements of castor oil.

PROCESSES OF MANUFACTURE.

The equipment of a castor-oil mill is identical in its main feature with that of a linseed-oil mill or of a cotton-seed-oil mill, that is, the mechanical unit of production is the hydraulic press. Oil is obtained from castor beans, as it now is most commonly from all oleaginous seeds, by hydraulic pressure. In the preparation of the beans for pressure and in the clarifying and refining of the oil after expression it is possible that slightly different processes are used in different mills; consequently, as is natural in a small industry like this, considerable

reserve is maintained by owners concerning even the mechanical operations of their plants. The principal features of the process of extracting oil from castor beans, however, are evident. The beans, first cleansed of fragments of capsules, stones, dust, etc., an operation that in the case of imported beans entails a loss of from 2 to 5 per cent, are not decorticated, as cotton seed is, nor crushed between rolls as most oleaginous seeds are, but are pressed whole. Decortication is not necessary, and the operation of crushing is impracticable, because the beans would cake too much upon the rolls. They are heated or not before pressure, according to the purposes for which the oil is destined. Heat renders the oil in the beans sufficiently liquid for easy expression, but, if carried to a degree higher than the hand can easily bear, has a tendency to discolor the oil and render it unfit for medicinal and undesirable for some other uses. The more common custom, therefore, is to press the beans cold by submitting them, inclosed in bags, to gradual pressure for the requisite length of time in a powerful hydraulic press. In most mills the practice seems to be to submit the beans to a single pressing. This custom differs from that prevailing in some other countries, where after the first pressing the pulp or pomace is removed from the press, broken into pieces, heated, and submitted to pressure a second or even a third time, each subsequent pressing, however, producing a lower grade of oil. The oil as it flows from the press is a whitish liquid, from which the starch, albumen, and mucilage are afterwards removed by careful processes of clarifying and refining; the resultant product is the castor oil of commerce.

Two grades are placed upon the market, known commercially as No. 1 and No. 3. The former grade commands the higher price and enters largely into medicinal uses; the latter is usually quoted at from one-half cent to 1 cent less per pound, and supplies various industrial needs. Both grades are sold by the pound, or unit of weight, and have lately been commanding from 9 to 11 cents per pound as compared with 10 to 12 cents per pound a few years ago.

CASTOR POMACE.

Two products are obtained from castor beans by the process of manufacture. The most valuable one, the primary object of the industry, is obviously oil; the other is a residual product, which is in reality an oil cake, but is commercially known as castor pomace. This latter product belongs to that class of oil cakes, including mustard-oil cakes, etc., which have no value as a cattle food, but are used only as fertilizers. In fact, castor pomace, retaining as it does the whole of the poisonous properties of the castor beans from which it is derived, is fatal to live stock. But, containing both potash and phosphoric acid, and being especially rich in nitrogen, it is well adapted to manurial uses. The high percentage of oil it contains prevents its rapid

decomposition in the soil, and thus prolongs its fertilizing effects. In some sections of the United States castor pomace is highly regarded as a fertilizer for tobacco and hops. In British India, where more of this by-product is made and used than in any other country, it is much esteemed as a manure for potatoes, wheat, oats, and corn. In the United States, however, the bulk of the output is sold direct to fertilizer factories, and thus enters into general fertilizing uses. The trade in this product is almost entirely domestic, little being exported and none imported.

YIELD OF OIL AND POMACE.

The yield of oil and pomace that may be obtained from a given quantity or weight of castor beans varies acording to the quality and condition of the beans and the climatic conditions under which they were produced. Beans of good quality contain about 45 per cent of oil, but 32 per cent is, on a general average, about the proportion of oil extracted by the process of manufacture used in the United States. The rather high proportion of about 13 per cent remains unexpressed in the pomace. The weight of imported castor beans as fixed by the United States tariff regulations is 50 pounds to the bushel, and consequently in the eastern mills it is customary to estimate the yield of oil and pomace, respectively, at 16 pounds (2 gallons) and 34 pounds to the bushel. In the West the weight per bushel of domestic castor beans is fixed at 46 pounds, and on this basis the yield of oil per bushel of beans would be 14.72 pounds (1.84 gallons) and of pomace 31.28 pounds.[a]

SOURCES OF SUPPLY OF CASTOR BEANS.

The castor-bean supply of the United States is derived almost entirely from two widely separate sources: The first, a few counties in Oklahoma, eastern Kansas, western Missouri, and southwestern Illinois, where for many years has been produced practically the entire domestic crop; the second, British India, a country which has long had almost a monopoly of the commercial castor-bean production of the world. The domestic crop, once sufficient to supply the entire demand—that is, of the eastern as well as the western mills—has of late years greatly declined. And at present a striking feature of this industry is that, although the castor oil used in the United States is manufactured almost wholly in domestic mills, the bulk of the beans from which it is expressed is imported from the opposite side of the earth. Although statistics upon domestic production are deficient, enough is known to warrant the statement that probably three-fourths, possibly four-fifths, of the castor oil manufactured in the United States is now made from imported beans.

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[a] In accordance with commercial usage, the imported beans referred to in this article are expressed in bushels of 50 pounds and the domestic product in bushels of 46 pounds.

THE UNITED STATES AS A SOURCE OF SUPPLY.

Of the production of castor beans in the United States historic records are meager. The plant is not indigenous to the Western Hemisphere; but philological research has led to the belief that it was introduced into the West Indies soon after their discovery. It is known to have been extensively cultivated in Jamaica in the eighteenth century, and to that fact can probably be credited the curious application of the word "castor" to this plant and oil. Resident Spaniards and Portuguese, having confused it with a totally different plant, the *Vitex agnus castus*, called it "agno casto." From this designation the English who traded in this oil coined the word castor, and thus gave rise to the name since applied to it throughout the English-speaking world.[a] This certainly seems a more reasonable origin of the word than that attributed to its fancied resemblance to castoreum, a product obtained from the beaver. The man who first brought castor beans into the United States has left no record of his achievement, and succeeding generations who fostered his enterprise have been scarcely less mute. A small crop, limited, at even the highest stage of its development, to groups of counties rather than to States, its early history is naturally lost in oblivion. The salient fact is that the crop has always been largely localized in parts of the States of Illinois, Missouri, and Kansas, and the Territory of Oklahoma. Incidental mention is found of its cultivation in Illinois before that State was admitted into the Union in 1818. Within the next quarter century there are occasional references to experimental culture in Georgia and other Southern States. But not until 1850 were there comprehensive data indicating the geographical distribution and extent of the crop.

ESTABLISHMENT OF CASTOR-OIL MILLS.

At the taking of the census in 1850 twenty-three castor-oil mills were reported for the entire United States; of these, ten were in the State of Illinois; three in each of the States of Missouri and Virginia; two each in Ohio and Tennessee; and one each in Pennsylvania, Alabama, and Arkansas. All were small establishments, doubtless of crude equipment, and evidently designed only for manufacturing the small crops of near-by farms, excepting that in Missouri St. Louis had already become, as it has since remained, the principal commercial center of castor-oil production in the West. As measured by the value of the oil produced, upward of 70 per cent of the total production of castor oil in the United States at that date was made in the Missouri mills. Though no statistics were taken of the actual production of castor beans, it is evident that the bulk of the entire crop was raised in territory tributary to St. Louis; in other words, as early as 1850

[a] De Candolle's Origin of Cultivated Plants.

the cultivation of castor beans was already largely specialized in that section, beyond which it has never extended on an important and enduring scale.

In the Eastern States the castor plant, on account of its ready susceptibility to injury from frost, and other causes, has never been cultivated for industrial purposes. But, on account of the important consumptive market there for castor oil and the facilities for importing castor beans, attention was early attracted to the industry on the Atlantic coast. In 1857 a mill was erected in Jersey City, N. J. This was the largest mill, equipped with the latest improvements in machinery and constructed exclusively for the manufacture of castor oil, that had been erected in the United States. The industry thus became largely centralized in Jersey City and St. Louis, cities which have since remained the leading markets for castor beans. The respective advantages of each location with reference to the two sources of supply, domestic and foreign, are obvious. Many small mills, about this time, went out of business, and at the taking of the census in 1860 only eight castor-oil mills were reported for the entire country against 23 in 1850. Of the capital invested in these, half was represented by the two mills in Jersey City and St. Louis.

OVERPRODUCTION OF CASTOR BEANS.

Soon after the civil war great local interest was revived in the producing sections in the culture of castor beans. In some years the crop exceeded the consumptive demand; even the supplies required in the East were drawn from the Western States, and the import trade from British India was threatened with extinction. Statistics of production as a whole were not collected, and comprehensive knowledge of the crop is not obtainable. The few figures that are extant, however, are valuable, in that they constitute the only statistical record upon this subject. As to Missouri and Oklahoma, beyond the fact that the crop was raised on a commercial scale, little is known. But in Kansas, which was then the chief producer, the State board of agriculture reported an increase in the crop from 59,435 bushels in 1873 to 766,143 bushels in 1879, the latter being the highest annual yield that has ever been reported for the State. There is reason for believing that this bumper crop in Kansas constituted practically the entire crop of the country. The Illinois State reports show the crop of that State in 1879 to have been only 24,314 bushels; and that the crops of Missouri and Oklahoma were not of great importance is indicated by the receipts of castor beans in St. Louis, which in that year were only 516,507 bushels, the bulk of which was undoubtedly from Kansas. The effect of this increase in domestic production upon imports was that the latter, which as early as 1867 had amounted to 60,588 bushels, declined to 1,655 bushels in 1879. Although castor beans are not a perishable product and can be carried over from year to year, the

effects of the heavy overproduction soon became apparent. Prices fell, and production rapidly declined until in 1884 it amounted in Kansas to only 89,183 bushels and to 19,295 bushels in Illinois. The import trade again became an important factor in the industry, the takings from British India attaining in that year the then unprecedented proportions of 262,505 bushels.

Up to this date few important changes had occurred in the industry of manufacturing castor oil. At the taking of the census in 1870 six mills were reported. All the old mills, excepting one each in St. Louis and Jersey City, had passed out of existence; but, as a result of tentative efforts to introduce the cultivation of castor beans into Texas and Tennessee, three new mills had been erected in the former and one in the latter State. These four mills were of small capacity and short-lived; at the taking of the next census they had disappeared. The annual output of oil for the whole country, as reported by the census, was 341,850 gallons, of which 270,000 gallons was the product of the two principal mills. Eight mills were reported by the census of 1880, but the only noteworthy addition to the old-established branch of the industry was a new mill in St. Louis and one in East St. Louis. The other four were small affairs, located in Ohio, Illinois, and Kansas. A notable increase in the output of oil over that of 1870 was reported, the total quantity being 893,802 gallons, the increase being partly due to the enormous overproduction of castor beans in Kansas in 1879 and to the introduction of improved machinery into the principal mills. The next important addition to the industry was the Kansas City, Mo., mill, which began operations in 1885.

DECLINE IN PRODUCTION OF CASTOR BEANS.

The subsequent history of castor-bean production in the United States is, as a whole, one of continuous, though irregular, decline. From the scant statistics upon the subject this is plainly apparent. In 1887 the crop of the single State of Kansas was reported by the State board of agriculture to be 405,488 bushels; in 1899 the entire crop of the United States, as returned by the census, was only 143,388 bushels. This heavy decline in production, though of late years common to all the producing States, was principally due to the abandonment of the crop in Kansas, the crop of 1887 never since having been equaled. That State, from being the leading producer, has become probably the smallest. Evidently, if the rate of decrease in Kansas—from a maximum of 766,148 bushels in 1879 to a minimum of 2,925 bushels in 1904—had been maintained in all the States, their crops would have long ago been practically extinct. But for many years as the crop of Kansas decreased, that of Oklahoma increased, though not in equal proportion, and that Territory has long been the chief source of supply for domestic castor beans crushed in the western mills. There are no means of determining the maximum

annual crop of Oklahoma, but in 1899, when the first and up to the present day the only Federal inquiry was made into the castor-bean production of the United States, it was found that the crop of that Territory amounted to 77,185 bushels, as compared with a production in Kansas of only 18,108 bushels, the latter figures; however, admittedly representing only about two-thirds of the crop. The relative importance of Oklahoma as a source of supply was further in evidence by the fact that the production in Missouri in the same year was given at 31,966 bushels, that of Illinois at 15,965 bushels, and the combined product of all other States at 434 bushels. The impulsion of this heavy fall in production has not been stayed up to the present day; though no figures are extant to show the exact limit reached, it is known that in general terms the annual castor-bean crop of the United States is now below 100,000 bushels. The quantity raised is insufficient for the demands even of the western mills. Lively competition arises each year in the principal producing sections for the possession of the crop, and the deficiency in western supplies is now made good, when the conditions of the trade warrant, by purchases of imported seed.

SUPPLY AND DEMAND.

Of the manufacturing industry to which castor beans give rise in the United States, little additional can be said. The activities of this industry have for almost a half century been limited to supplying the varying domestic demand for castor oil, for no noteworthy export trade exists and imports are of negligible quantities. The domestic uses of this oil, moreover, important as they are from an economic point of view, are peculiar, in that they absorb only moderate quantities. This is true even in the textile industry. However, there has been an increase, especially in recent years, in the demand in this country for castor oil. Notwithstanding the continuous decline for two decades past in the domestic crop of castor beans, additional capital has occasionally been attracted to the manufacture of this oil, and there has been some expansion in the total productive capacity, especially on the Atlantic coast. In the eighties a mill was erected in Brooklyn, in the nineties another was started in Boston, and within the last few years the manufacture of this oil has been taken up in Memphis, Tenn. But, beyond the mere fact of noting their existence, little significance attaches in this industry to a mere enumeration of mills. The irregularity of operation in some establishments, the long periods of inactivity in others, and a natural reticence among operators to reveal the workings of their plants render it impossible to form any exact idea from productive capacity of the country's actual output of oil. Moreover, except in 1899, no statistics as to the total castor-bean crop have ever been collected. The only factor in the annual supply that is known with exactness is the quantities imported.

In recent years that factor has become very important. Instead of Kansas and Oklahoma, the chief source of supply is now the port of New York. In the fiscal year 1902–3 imports of castor beans into the United States amounted to 380,270 bushels, or potentially 760,540 gallons of oil; in 1903–4 the quantity imported amounted to 498,039 bushels, representing in oil 996,078 gallons. The domestic crop of castor beans, though statistically an unknown quantity, is known to have fallen greatly below the 150,000 bushels reported for 1899 by the United States census. Assuming the crop to have been a round 100,000 bushels in 1903, the quantity of castor beans available for manufacture in the year 1903–4 would therefore have been 598,039 bushels, or potentially about 1,200,000 gallons of oil, with a resultant by-product of upward of 10,000 tons of castor pomace. The present most striking characteristic of this industry is its heavy dependence for supplies upon British India.

DISTRIBUTION OF THE CASTOR BEAN.

The castor plant is one of the most interesting in the world's flora. Tropical in its origin, the antiquity of its culture is attested, first, by seeds found in the sarcophagi of the ancient Egyptians, and, later, by records of the utility of the plant in the earliest writings of the Hindus. Indigenous either to Africa or India, it has been carried by the many migrations of men in the course of ages to all parts of the tropical and subtropical world. The remarkable beauty of its foliage has also led to its culture as an ornamental plant far north of where it can be raised for industrial uses. A perennial in tropical climes, it grows to a height of 30 or 40 feet, but acclimated in cooler zones it becomes an annual, and attains a height of only from 8 to 12 feet. From the botanical, as distinguished from the cultural, point of view it is now widely distributed over all the warmer regions of earth. In our own possessions it grows wild in Porto Rico, is cultivated for oil to a small extent in Hawaii, and is also found in the Philippines. Cultivated in Mexico, there is official record of an increase of the crop from 57,000 bushels in 1900 to 327,000 bushels in 1902. The plant grows wild in many parts of South America, notably in Paraguay and Argentina, and a small export trade in castor beans is carried on from Brazil. It is cultivated in a small way in southern Europe, in northern and central Africa, and eastward, in about the same latitudes, grows sometimes wild, sometimes under cultivation, in Arabia, Persia, and, in fact, in most of the warmer countries and islands of the Oriental world. The botanical distribution of the plant, however, has little economic significance. In few countries does its cultivation give rise to even a small international trade in its products, and in none, except Mexico, are there statistical records of yield.

BRITISH INDIA AS A SOURCE OF SUPPLY.

The one great castor-bean producing country of the world is British India. Although not produced there, as crops are reckoned in these days, in mammoth proportions, that country probably has a greater monopoly of the world's production of castor beans than has the United States of the world's crop of cotton or of corn. From British India is derived almost the entire supply of castor beans that enters into the international trade of the civilized world. A manufacturer of castor oil, too, on a large scale, her exports of the manufactured product far exceed those of any other nation. From British India the United States, England, France, Germany, Belgium, and Italy, all manufacturers of castor oil, derive practically their entire imports of castor beans. From the same source Australia, Natal, Cape Colony, the Straits Settlements, and Ceylon, all heavy consumers of the manufactured product, derive the bulk of their supplies of castor oil. No records exist of the production of British India, but the following statement of the total exports of castor beans and castor oil from that dependency to all countries since 1890 will illustrate the magnitude of her export trade; to the statement is added for comparative purposes a record of the imports of castor beans and castor oil into the United States.

Exports of castor beans and castor oil from British India, and imports into the United States, 1890–1904.

Year ending March 31—	Exports from British India.		Year ending June 30—	Imports into the United States.	
	Castor beans.	Castor oil.		Castor beans.	Castor oil.
	Bushels of 50 lbs.	*Gallons.*		*Bushels of 50 lbs.*	*Gallons.*
1904	3,509,717	2,300,015	1904	498,039	11,283
1903	3,509,781	2,488,910	1903	380,270	6,643
1902	2,965,527	2,424,270	1902	312,323	3,705
1901	1,962,121	1,843,207	1901	191,288	3,206
1900	1,978,731	1,833,842	1900	135,591	3,334
1899	2,710,709	2,569,725	1899	25,003	7,615
1898	2,372,516	2,344,797	1898	19,651	3,626
1897	2,235,778	2,397,653	1897	84,128	4,368
1896	2,348,201	2,420,358	1896	145,735	22,888
1895	2,631,765	3,215,887	1895	277,231	26,846
1894	2,481,369	2,754,261	1894	47,448	1,702
1893	2,216,556	3,095,564	1893	147,061	286
1892	1,872,472	3,929,758	1892	163,089	382
1891	1,925,889	3,789,628	1891	105,374	2,073
1890	2,003,973	3,198,787	1890	94,226	6,901

Two varieties of castor beans are produced in British India—a large-seeded variety and a small-seeded variety, the latter of which yields the better quality of oil. Both varieties are imported into the United States. Madras, Coromandel, and Bombay are the chief sources of supply, the small variety exclusively being imported from Bombay and both varieties from Madras. Small quantities of castor beans are also imported from Brazil. The exclusive port of entry is the port of New York.

THE NUT WEEVILS.

By F. H. Chittenden, Sc. D.,
In Charge of Breeding Experiments, Bureau of Entomology.

Introduction.

Nut-growing in the United States would be a much more profitable industry were it not for the insects which inhabit the kernels, rendering them unfit for food. This is especially true of the chestnut and chinquapin and to a lesser extent of pecan, hickory, and hazel nuts; while others, which include butternuts, walnuts, and almonds, suffer little or no injury from this source. Considerable diminution in the yield of many forms of nuts is also caused by the inroads of insect larvæ in the growing husks. Examples of the first class are the chestnut "worms" or weevils; of the second, the husk-worms and walnut curculio. The present paper will be restricted to a consideration of the weevils.

The chestnut crop suffers the greatest loss, and the chief depredators are the grub-like "worms" or larvæ with which everyone is too distressingly familiar. These larvæ develop with the nuts, so that those which first attain maturity are ready to leave and enter the ground nearly as soon as the nuts are gathered; others remain in the nuts some weeks later; so it frequently happens that when nuts are packed for shipment in bags or barrels, some nuts which were apparently sound when shipped are found, on reaching their destination, with one or more holes in their shells (fig. 17), while the repulsive grubs crawl about at the bottom of the receptacle. How to cope with these weevils has long been a most vexatious problem.

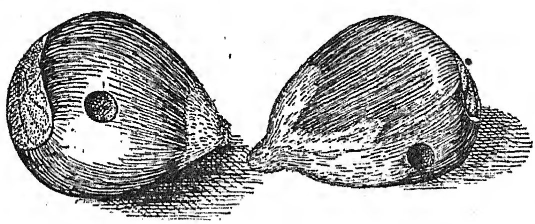

Fig. 17.—Chestnuts showing exit holes of chestnut weevil larvæ—enlarged one-fourth (author's illustration).

The Chestnut Weevils.

In comparatively recent years chestnut culture has assumed considerable proportions, and has taken a new impetus since the extensive introduction and development of Japanese and European varieties. These are grafted on American seedlings or native stocks, and thus many valueless trees on equally unpromising soil are converted into

sources of profit. Were it not for the "worms," borers, and "blights," chestnut growing might develop into a most lucrative industry in regions adapted to it.

ESTIMATES OF LOSSES.—A fair estimate of the damage done annually by weevils to chestnuts grown in the United States would probably fall little short of 25 per cent, while in some years the percentage exceeds that figure, running as high as 40 or 50 per cent. Growers in some localities report no damage, others place losses as low as 5 or 10 per cent, while instances are cited of whole crops being destroyed. The amount of loss is dependent on locality, season, and to a more limited extent on the variety of nuts grown. The greatest damage is usually incurred in regions where chestnuts have grown wild for many years, and the least where there are no wild chestnuts or chinquapins and the nuts are grown only for market and are carefully gathered. The most extensive losses, judging from available sources of information, appear to be in Massachusetts, Pennsylvania, New Jersey, New York (in the vicinity of New York City), Delaware, Maryland, Virginia, Tennessee, and North Carolina.

In Georgia, Spanish and Japanese varieties have been cultivated for years without attack by weevils being noticed. In New Jersey, 50 per cent of the same varieties have been ruined. A grower in Missouri has reported no damage to 50 trees of an American variety; another at South Haven, Mich., has reported no injury for a period of three or four years to Japanese and Spanish chestnuts grown there, while from 5 to 20 per cent of the crop of native nuts was annually destroyed. The nearly complete destruction of the chestnut crop of New Jersey for 1893 was reported.

THE SPECIES OF CHESTNUT WEEVILS.—The species of weevils which infest chestnuts are two in number—the larger chestnut weevil, *Balaninus proboscideus* Fab., and the lesser chestnut weevil, *B. rectus* Say. They have extremely long, slender beaks or snouts, nearly as fine as a horsehair, and considerably longer than the body in the female. By means of this long beak the female is able to penetrate the thickest burr of the chestnut with its long spines and to cut out, with the minute and sharp mandibles at the tip of her beak, a little hole for the deposition of her eggs. These are inserted through the husk into the growing nut.

The two species resemble each other greatly in color and in markings, the general color of both being golden yellow, ochraceous or clay yellow, frequently tinged with olive, and a little paler on the lower surface. The disk of the thorax is a little darker, with a wide bright band on each side, and the elytra, or wing-covers, are mottled with rich light brown or dark brown markings of variable size and extent.[a]

[a] Occasional individuals lack the darker markings, some being paler, others darker, even reddish. The ground color, as may be seen in abraded specimens, is really black, and the apparent color is due to scales very similar to those of butterflies and moths.

THE LARGER CHESTNUT WEEVIL.

(*Balaninus proboscideus* Fab.)

The larger chestnut weevil (fig. 18) is considerably the larger and more robust species. The female rostrum or beak, although proportionately of about the same length as in the lesser weevil, is perceptibly more prominent because less curved, the curvature being toward the tip. It is also more widened at the base. The body measures from one-third to nearly one-half of an inch in length, and the beak of the female is often five-eighths of an inch long. That of the male (fig. 18, *c*) is nearly as long as the elytra. The egg is small, about one-sixteenth of an inch long, and of the outline shown in figure 19, *d*. It is nearly white, partially translucent, and without sculpture.

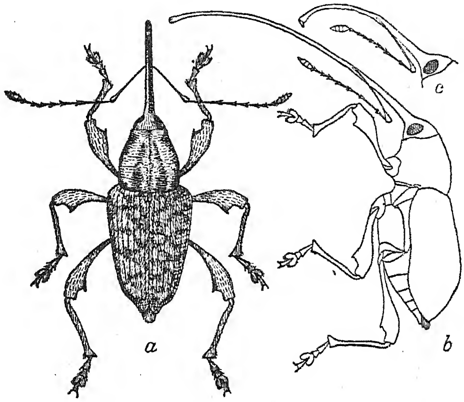

FIG. 18.—The larger chestnut weevil (*Balaninus proboscideus*): *a*, female beetle; *b*, same in outline from side; *c*, head, rostrum, and antenna of male—three times natural size (original).

The larva (fig. 19, *a*) is milk-white, robust, fully three times as long as wide, with the dorsal or upper portion rounded and convex. The entire surface is very strongly wrinkled transversely, and there are a few very short hairs scattered sparsely over the different segments. The head (fig. 20) is about one-fourth as wide as the widest portion of the body. It is provided with short but strong mandibles, by means of which it gnaws the kernel constituting its food. The fully developed larva in ordinary resting position measures nearly half an inch. Although the larva has no true legs, it is able to crawl, slowly and clumsily, it is true, by means of the flattened lower surface, locomotion being aided by transverse wrinkles.

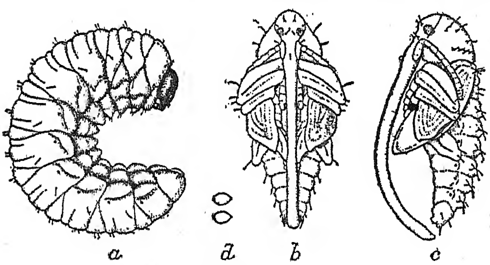

FIG. 19.—Larger chestnut weevil (*Balaninus proboscideus*): *a*, larva; *b*, *c*, female pupa; *d*, eggs—all enlarged (original).

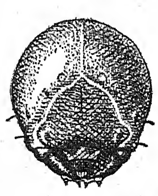

FIG. 20.—*Balaninus proboscideus*: head—much enlarged (author's illustration).

The pupa is of a clearer whitish color than the larva, and shows the principal external organs of the body of the future beetle, all, except the beak, folded tightly to the body. The female pupa is illustrated in figure 19, *b*, *c*.

This species, like the other weevils under consideration, is native to America and is known from Rhode Island to Virginia, the District of Columbia, southern Ohio, and Tennessee, and westward to Kansas. The geographical distribution of this and the other nut weevils has as yet not been carefully studied, but in all probability it is considerably more extensive than above stated.

In some regions this species is quite generally known as the chinquapin weevil, but the investigations conducted during 1904 indicate that, although it breeds in chinquapins and more commonly in chestnuts, it occurs in greater abundance in the larger imported nuts.

THE LESSER CHESTNUT WEEVIL.

(*Balaninus rectus* Say.)

The lesser chestnut weevil (fig. 21) has the scape of the antenna longer than in the preceding species and the first joint longer than the second.[a] The average length of the body is about one-fourth of an inch, but the size varies, as in all of these insects.

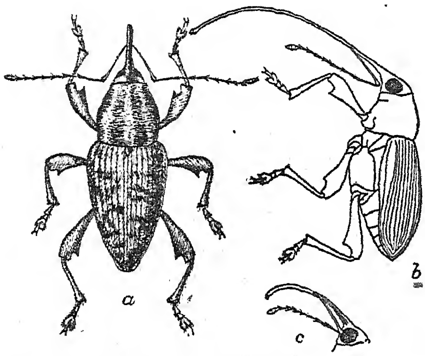

FIG. 21.—Lesser chestnut weevil (*Balaninus rectus*), adult: *a*, female, dorsal view; *b*, female, lateral view; *c*, head of male—much enlarged (author's illustration).

The distribution of this species extends from Canada and Massachusetts to North Carolina, Tennessee, and Ohio, and probably farther westward. The writer has seen sets of specimens labeled "Arizona." Although in some localities the larger species is much more in evidence, taken all in all, the lesser weevil is the more common and is probably even more widely disseminated.

The egg has not come under observation, but is undoubtedly very similar to that of the preceding, being proportionately smaller, which is true of the remaining stages.

The larva is only a third of an inch long and its length is about three times its width. The body is milk-white and the head light brownish yellow, while the ⅄-mark has a short lateral branch each side.

The pupa differs from that of the larger species by size and by characters shown in figure 22, which illustrates the male.

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[a] In the larger species the first joint (omitting the scape) is shorter than the second. In the female *rectus* the rostrum is strongly curved, the thorax is longer than wide, and the elytra are strongly acuminate apically. The tooth with which the thighs are armed is small, with the entering angle rounded.

LIFE HISTORY OF BOTH SPECIES.

The life history of our two chestnut weevils is so similar as to be practically the same for both species. There are, however, minor differences. These, as well as related nut and acorn weevils, hibernate exclusively in the larval condition and in the soil. Both make their first appearance at about the same time—with the first blooming of chestnuts—but this period may vary from late in June to July, according to locality and season, or, more properly speaking, the mean temperature. At this time the beetles are found rarely and scatteringly, and as oviposition has not been observed then it is doubtful whether it begins until considerably later. What function these early arrivals fulfill is problematical. The beetles increase in number as the nuts approach maturity, or until about the middle of September or a little time before the nuts are first marketed. Then they may be seen in greater abundance, several pairs, frequently of both species, often occurring on a single bunch of burrs (Pl. XXVIII). As it requires about two weeks for the egg to develop, it is not probable that they are laid much earlier than when the nut begins to form. From examination of many burrs gathered in the fall of 1904 by Mr. F. C. Pratt, of the Bureau of Entomology, who visited some of the principal chestnut groves of Pennsylvania and Virginia at the urgent request of growers in those States, it is deduced that the first eggs deposited are laid (seldom and very sparingly) in the soft, woolly material surrounding the forming nut; but later they are inserted in the kernel just under the inner skin, and occasionally they are deposited somewhat more deeply. In no case has the egg been found in the outer husk.

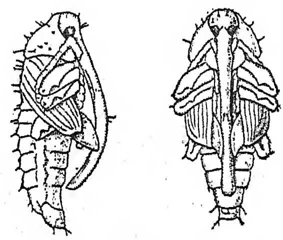


FIG. 22.—Lesser chestnut weevil (*Balaninus rectus*): pupa, from side, at left; ventral view at right—enlarged (original).

Eggs are laid singly, but many are placed in a single nut, as high as 40 or more (of the smaller weevil) in imported nuts, and as many as 9 in native nuts. The larvæ when hatched feed on the tissue of the growing kernels, enlarging with their own growth the cells thus made. When, as is usual, several larvæ inhabit the same nut, the interior is more or less completely hollowed out, and large masses of excrement are left behind (Pl. XXIX).

By the end of September or the first week of October the beetles disappear. At about the same time, when the nuts first fall, the larvæ begin to mature and issue from round orifices which they gnaw through the shell and which vary in diameter from one-sixteenth of an inch, in the case of the smaller species, to one-eighth of an inch in the larger (see fig. 23). By the size of these holes alone it can be readily determined which species is the dominant one in any given locality. Rarely

larvæ bore through the burr. On leaving the nuts they burrow into the earth to depths varying from 2 to about 8 inches, according to the hardness of the soil. If confined in soft earth or sand they penetrate still deeper. The larval period probably lasts from three to five weeks in the nuts, and about ten months in the earth, pupation taking place within three weeks of the issuance of the beetle, the latter remaining several days in the earth before appearing above ground.

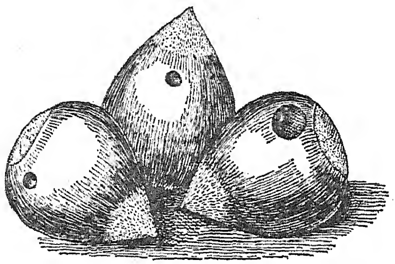


FIG. 23.—Chinquapins, showing injury by lesser chestnut weevil at left; of larger weevil at right—enlarged (original).

The beetles do not fly readily, but cling tightly to their resting place or drop when disturbed; yet, as their bodies are not heavy and their wings strong, they are obviously able to cover considerable distances, especially with the wind. Ordinarily, however, they are sluggish, like most other weevils, and probably do not go far from the vicinity of the trees which have sheltered them as larvæ, although they undoubtedly migrate when food is scarce.

NATURAL ENEMIES.

A natural enemy of the nut weevils is known, a small four-winged wasplike fly, the Braconid parasite *Urosigalphus armatus* Ashm., which develops in the body of the larva.[a]

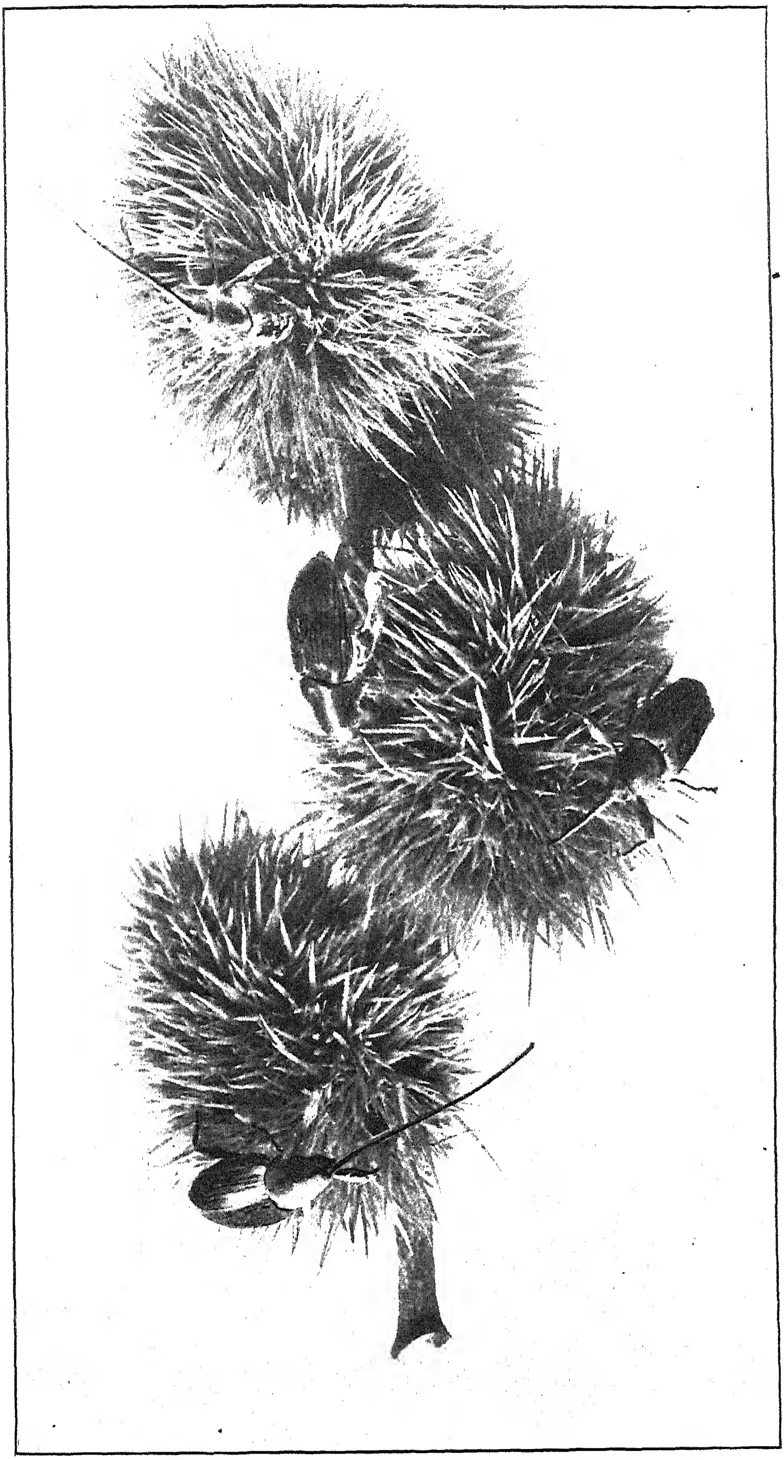
METHODS OF CONTROL.

The most practical remedy for nut weevils that can be suggested is the early destruction of the "worms" in the nuts by means of bisulphid of carbon and the observance of clean orchard management and other cultural methods. It may be well to preface the discussion of these methods with a statement of the uselessness against nut weevils of ordinary measures employed in the control of similar insects.

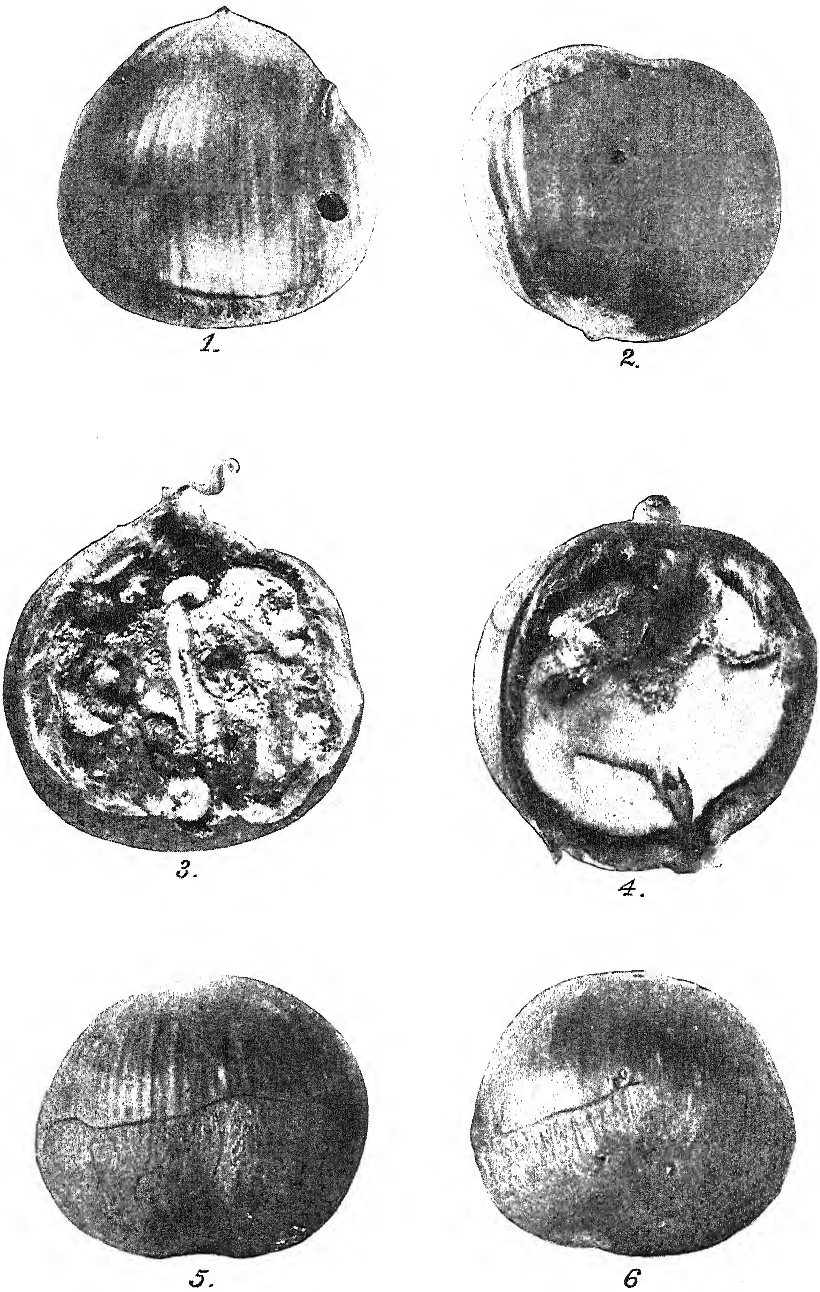
UNSATISFACTORY METHODS.

STOMACH POISONS.—The peculiar structure, in the nut weevils, of the mouth-parts (minute mandibles placed at the end of a beak nearly as fine as horsehair and as long or longer than the body) is almost sufficient proof in itself that these insects do not feed on leaves, but depend for sustenance on the substance of the growing nuts. The beetles first appearing feed on the undeveloped, very young nuts and the juices within the husk. There is, therefore, no seeming possibility of reaching them with a spray of Paris green or other stomach poison,

[a] Two other insects are associated with the weevils and are probably also their enemies, a Proctotrypid parasite, *Trichasis rufipes* Ashm., and a predatory Reduviid bug, *Acholla multispinosa* DeG.



LARGER CHESTNUT WEEVIL ON CHINQUAPIN BURRS.
[Twice natural size. Original.]



IMPORTED NUTS SHOWING DIFFERENT FORMS OF INJURY BY NUT WEEVILS.

FIG. 1.—Parry's Giant nut, showing exit hole of *Balaninus proboscideus*. FIG. 2.—Same of *B. rectus*. FIG. 3.—Interior Paragon nut, showing larvæ of *B. rectus* in situ. FIG. 4.—Same, showing work of one individual of *B. proboscideus*. FIG. 5.—Reverse side of figure 2, showing scars made by puncture of female *B. rectus* in ovipositing. FIG. 6.—Reverse of figure 1, with puncture of *B. proboscideus*.—All natural size (original).

particularly as we are unable to place the insecticide where they would eat enough to kill them.

Trap crops.—The cultivation of special varieties of nuts with a view to securing immunity from attack or as a means of luring the insects from the main crop does not offer any degree of promise. The Paragon, Cooper, and Ridgeley varieties, according to Mr. G. H. Powell, of the Bureau of Plant Industry, suffer greater loss from weevil attack than Japanese varieties. Chinquapins are favored by the smaller weevil and suffer far more damage, as a rule, than wild chestnuts. It is possible that the planting of the varieties specified, or, better, of chinquapins, at intervals around, as also through, orchards of the least affected varieties might lessen the loss to the main crop. If a variety could be produced which would mature fruit before the advent of the beetles in greatest numbers, this would partially solve the problem, particularly as the earliest nuts bring the highest prices. The nuts gathered toward the end of the season are comparatively uninjured, but by this time the market value is considerably lower.

Contact poisons.—Scarcely more can be expected from the use of contact poisons, such as kerosene emulsion, since in view of the long period spent by these weevils in the adult stage (from June and July to September or October) such frequent application would be necessary that the expense would destroy the profit.

Jarring the trees, as practiced against the plum curculio, is for the same and other reasons equally impracticable, save, perhaps, on young trees grown in a small way.

The water test of infestation.—Having doubts of the efficacy of this old-fashioned test of the difference between "wormy" and healthy nuts, an experiment was made by the writer with native chestnuts obtained from a street vender. To begin, 40 per cent were obviously "wormy," and only 60 per cent apparently sound.

Results of water test with native chestnuts.

Nuts which rose to surface.		Nuts which remained on bottom.	
	Per cent.		*Per cent.*
Uninfested	10	In perfect condition	40
Showing minute marks only; good flavor; salable	20	Slightly injured	30
Containing full-grown grubs	10	Badly infested	20
Containing immature grubs	60	Completely filled with grubs	10

As will be seen from this experiment, noticeably wormy nuts, as evidenced by loss of weight and the exit holes of the "worms," naturally rise when placed in water, but the remaining nuts may or may not be infested, and hence require further test than whether they will sink or float.

DIRECT REMEDIES.

BISULPHID OF CARBON.—The value of bisulphid of carbon as a fumigant for chestnuts infested by weevils is now fully established. Although at first thought it would seem difficult for the gas to penetrate through shells so firm and compact and kill the larvæ, nevertheless a prominent grower in Pennsylvania successfully uses the bisulphid, applying it when the nuts are first harvested. The dead weevil larvæ are at this time so small that the average person would never detect their presence, while if they were permitted to develop they would soon destroy the nut for food. Bisulphid of carbon has been used on the largest chestnuts grown in this country, and, since a score or two of larvæ find shelter in a single nut, one can appreciate the desirability of prompt fumigation. The grower mentioned uses bisulphid of carbon at the rate of 1 ounce to a bushel of Paragon nuts placed in a kerosene barrel of about 50 gallons capacity and covered by sacking. After an exposure of about sixteen hours the nuts are removed, the larvæ being then practically all destroyed. Several hundred pounds were treated in 1904 in this manner with perfectly satisfactory results. To verify reported results, Mr. Pratt was detailed to visit the infested orchard and witness the process. This method could be employed at less expense by using tightly fitting covers, the effectiveness of the fumigation being in exact proportion to the tightness of the receptacle and the length of exposure to the fumes. Therefore, a longer exposure of one or two days, with perhaps one-half ounce of bisulphid, should accomplish the same purpose.

SCALDING AND DRYING.—Some growers make a practice of plunging the nuts as gathered into boiling water just long enough to kill the contained insects and yet not injure the nuts for sale, after which they are dried before being marketed. This may be profitably accomplished by using a large sieve, which is filled with nuts, dipped in the water, and removed in about five minutes. The late W. P. Corsa used a washtub, in which was placed a bushel or so of nuts, pouring in enough boiling water to come an inch or two above the nuts. Then, by stirring vigorously with a stick, the bulk of the weevily nuts would come to the surface in the same manner as do peas and beans affected by weevils.[a] The infested nuts are skimmed off and destroyed, or they may with profit and safety be fed to hogs, provided the animals do not have a too exclusive diet of this form of food. Salt water, it is claimed, is preferable for scalding, the brine serving to keep the shell soft and pliable and rendering the kernels more palatable than when not thus treated.

Different methods are employed in drying. A good way is to place the nuts in the sun and agitate them occasionally by stirring or

[a] Note the writer's observations on this head on p. 305.

shaking in a bag until thoroughly dry, because if moisture remains unevaporated it is apt to form mildew when the nuts are prematurely packed for shipment.

Nuts for planting should not be scalded, and care should be taken not to cook the kernels of nuts intended for sale. Some growers claim that the hot-water treatment is objectionable because the nutshells lose a certain degree of polish, rendering them less desirable for market.

Heat.—Infested nuts can be subjected to a temperature of between 125° F. and 150° F. without injuring them for food or for seed, and this will effect the destruction of the larvæ within. Some growers of chestnuts destroy the weevils by kiln-drying.

Cold storage.—Cold storage has been employed and is successful in arresting the development of the larvæ. The appearance of the nuts is scarcely different from that of those not so stored, but nuts thus treated and submitted to the writer after becoming dry were deficient in flavor, having an acrid and moldy taste.

A crude form of cold storage has been successfully followed by a Virginia grower. It consists in placing nuts in the earth under the shade afforded by his house, where the soil temperature, after the nuts are gathered, does not exceed 50°. Since most insects are inactive below 51° this has the effect of restraining their development, causing the eggs or minute larvæ to die.

Preventives.

Choice of location for the orchard.—The selection for the planting or grafting of chestnuts of a locality with reference to the chances of immunity from injury by nut weevils is a matter of great importance. For this reason it is most undesirable to plant in the immediate vicinity of woodland abounding in wild chestnut and chinquapin, since these trees furnish natural breeding places for the insects, and are, therefore, a constant menace to successful chestnut culture. Too frequently growers suffer losses from weevils because they neglect to gather the wild chestnuts or chinquapins in the immediate vicinity of their cultivated groves. Another phase of bad management which is frequently practiced is the grafting of cultivated varieties on native chestnuts growing in rocky and uneven soil, often on hillsides, as shown in Plate XXX, figure 1. In such places it is impossible to harvest a complete crop, and, what is of equal importance, to gather the remnants. Hence, to secure these results, it is imperative to plant or graft trees on smooth ground (Pl. XXX, fig. 2), first for the sake of economy, and second to permit the collection of all of the nuts, leaving none for the propagation of weevils. It is also necessary to keep the soil clean of herbage, as shown at the left of figure 2, Plate XXX, not overgrown with brush, as illustrated at the right.

CAREFUL HARVESTING.—It is always advisable to gather the entire crop, leaving none on the ground, and either place the nuts in tight receptacles or fumigate with bisulphid of carbon before marketing. The grubs crawl out soon after the nuts have been gathered, and as they require considerable moisture they will die if confined in closed barrels or boxes. The trouble is that enough nuts are usually left in orchards or in adjoining wood or forest land to serve for the propagation of the insects the following year. In order to make the method of treatment here described thorough, it will be necessary to secure the cooperation of neighboring landowners who grow chestnuts for market and of all who own woodland containing chestnut and chinquapin.

The collection of remnants can be made by children or the unemployed. It is also profitable to allow hogs the run of the orchards to destroy what nuts remain after the crop has been harvested. In the mountainous sections of Virginia and Pennsylvania it is a common practice to fatten swine on the unpicked fallen nuts. Hogs fatten on nuts and acorns as well as on corn, and without expense to the grower.

COOPERATION.—The results of the observance of clean farming on the lines that have been indicated may not at once be apparent, but in course of time, if this work is systematically carried out by all growers over a considerable territory, infestation will be very materially decreased. An important point is to ascertain how far the insects fly. Their structure indicates that they are strong fliers and capable, with favoring winds, of migrating considerable distances; but under ordinary circumstances they probably do not fly many miles at a time or in a given year.

THE PECAN WEEVIL.

(*Balaninus caryæ* Horn.)

With the increase of pecan culture in our southern States frequent inquiry is made in regard to the cause of the holes in the nuts (fig. 24), and during 1903 and 1904 there were reports of great injury of this nature, more particularly to pecans grown in Texas, where considerable loss was reported, and in Georgia, where in one locality 75 per cent of the crop was a failure. A shortage has also been reported in Mississippi. The insect involved in these cases is the pecan or hickory-nut weevil, a pest which is evidently destined to become one of the

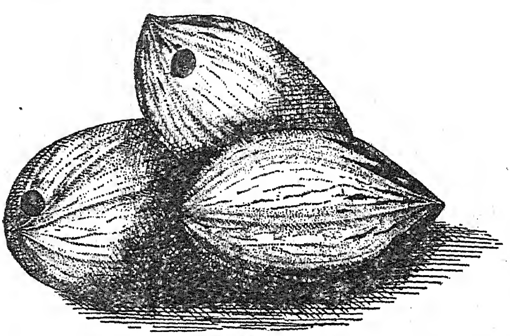


FIG. 24.—Pecan nuts showing exit hole of pecan weevil larvæ—one-third enlarged (author's illustration).

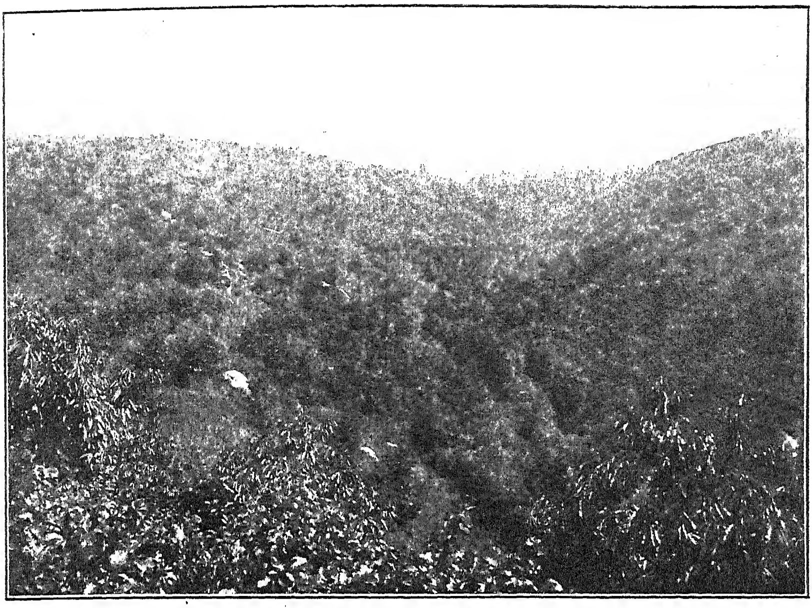


FIG. 1.—PARAGON CHESTNUT ORCHARD, GROWING ON HILLSIDES, SHOWING IMPOSSIBILITY OF CLEAN ORCHARD MANAGEMENT.

[From photograph by E. G. Reist.]

FIG. 2.—PARAGON CHESTNUT GROWING ON PLANE SURFACE, WHERE CLEAN METHODS OF CULTIVATION CAN BE PRACTICED.

[From photograph by E. G. Reist.]

principal drawbacks to the cultivation of the pecan. Indeed, in many parts of the South it already divides that distinction with the husk-worm, so that it has been truthfully said that what the husk-worm leaves the weevil destroys.

The beetle (fig. 25) is about the same size as the larger chestnut weevil, from which it may be distinguished by its much duller color[a] and by the relative lengths of the first and second antennal joints, the first joint being longer than the second in the pecan-infesting species.

The larva differs from that of *proboscideus* in being decidedly yellow, having the head bright red and wider than long. Its cervical plate also is darker. The pupa is similar to that of the larger chestnut weevil.

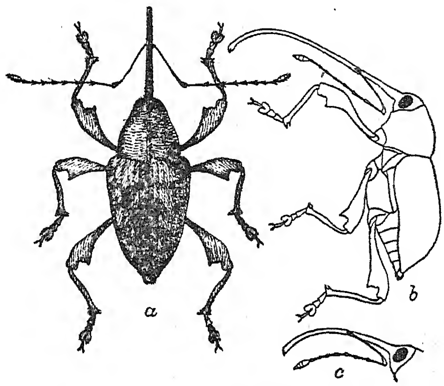


FIG. 25.—Pecan weevil (*Balaninus caryæ*): *a*, female, dorsal view; *b*, same, lateral view, in outline; *c*, head with rostrum and antenna of male—about two and one-half times natural size (author's illustration).

The distribution extends from New York to the Gulf, and westward at least to Iowa.

The life history of this weevil, as it occurs in the pecan in the South, is, so far as can be gathered from reports from Georgia and Texas and from laboratory experiments, very similar to that of the chestnut weevils. According to the observations of Mr. H. A. Halbert, at Coleman, Tex., the female begins to deposit her eggs in August while the pecan is still immature, and the larva usually escapes from the nuts in the latter part of September and in October; but most of them do not issue until the husks open, allowing the nuts to fall. In Georgia they have been found in the nuts as late as the middle of January.

REMEDIES.

The same care in the selection of the site for a pecan orchard is advised as in the case of chestnut culture, with this difference, that the grower should avoid planting in the vicinity of wild pecan and hickory of whatever kind. The entire crop, also, should be harvested or hogs should be turned in to devour what nuts are left. At Thomasville, Ga., Mr. Wilmon Newell observed in 1904 that where swine and chickens had had access to a pecan grove, the ground was well rooted and scratched up and there was less loss from weevils than in the pre-

[a] The ground color is uniform dark brown, nearly black, and the scaly covering (which characterizes the chestnut weevils) in this species is hair-like on the thorax, fine and somewhat sparse on the wing-covers, and much duller, with little or no mottling. Moreover, the beak of the female is, comparatively, a little shorter, although of about the same curvature, and is less widened at the base.

vious year. Evidently both hogs and poultry devour the larvæ in the ground.

At the time that bisulphid of carbon was first suggested as a remedy for chestnut "worms" it was feared that the firm and compact shell would hardly permit the gas to penetrate and kill the contained larvæ. Experience, however, has shown that this remedy is successful in the case of chestnuts, and it is not impossible that it might be adapted to pecans, using a larger amount of the chemical and a longer exposure in a perfectly tight receptacle. We can as yet scarcely advise this method on a large scale, but it should certainly be tried experimentally.

The Hazelnut Weevil.

(*Balaninus obtusus* Blanch.)

Hazelnuts or filberts are injured in much the same manner as are chestnuts and pecans and by a similar weevil. Injury was recognized as early as 1841, but was attributed to other species than that under consideration. Owing to the comparatively slight importance of the hazel as a nut tree in this country, few notices of losses from weevil attack have been recorded. The weevil which affects the nut was not differentiated from others of its kind until 1884. In 1891 it was reported as badly damaging hazelnuts in Iowa.

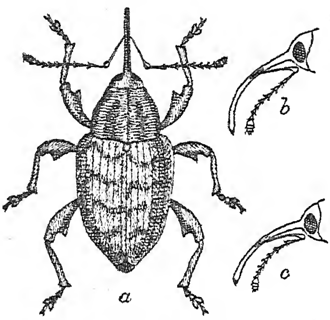


FIG. 26.—Hazelnut weevil (*Balaninus obtusus*), adult: *a*, female, dorsal view; *b*, head from side; *c*, head of male from side—enlarged (original).

The beetle (fig. 26) differs from others which attack edible nuts, exclusive of acorns, by its shorter, more robust form and shorter beak.[a] It is about one-fourth of an inch in length, and the beak does not exceed half the length of the body. The vestiture varies from gray to ochreous, and the elytra are moderately mottled.

This species occurs from Massachusetts and New Hampshire, westward to Minnesota and Texas. Injury has been noted in Massachusetts, New York, Indiana, Iowa, and Minnesota.

Of the life history little has been recorded beyond the fact that the "worm" issues from the side of the nut, and that paired adults have been found on hazelnuts in July.

REMEDIES.

Since hazels are not cultivated in this country to any extent, no remedy need be employed other than gathering entire crops and destroying isolated bushes where it is unprofitable to gather the nuts. It would be quite possible, owing to the small size of the hazel plant, to control this species by jarring, as for the plum curculio.

[a] The appendices of the claws are broadly rectangular, and the femora or thighs are armed with large teeth. The scape of the antenna in the female is long.

POTATO CULTURE NEAR GREELEY, COLORADO.

By J. MAX CLARK,

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INTRODUCTION.

For more than twenty years Greeley has been famous in all the Western States for both the quantity and the quality of its potato crops. From very small beginnings in the gardens of the town in the spring of 1870, when the Union Colony settled at this point in the Poudre Valley, through larger experiments, first in 5-acre tracts planted in the outskirts of the place in 1871, then in 10 and 20 acre fields, planted under colony canal No. 2 in 1872, and still larger areas with each recurring year since those times, the business has grown to its present important proportions. The district devoted to this leading product, if we compare it with the unirrigated areas in the arable States to the east of us planted in corn or other crops, is of course of very limited extent; but it is probable that no other section of equal extent, East or West, in any State in the Union, where there is systematic cultivation of general farm crops, can compare with it, either in the annual aggregate of gross products or in the amount of money realized from them.

EXTENT OF THE GREELEY POTATO AREA AND MARKETS.

Greeley is the principal shipping point of this potato area, which extends to New Windsor on the west, to Eaton and Ault on the north, and to Lasalle and Kersey on the south and east, none of which points is more than 12 miles distant from Greeley. The region described in these general terms includes perhaps 300,000 acres, but much of this is unirrigated land. It probably includes not more than 125,000 acres of tillable irrigated land. Not more than half of this is ever planted to potatoes, and of the portion which from experience has been found especially adapted to this crop not more than 25,000 or 30,000 acres are planted to potatoes in any one year. Within this small compass, all in Weld County, are grown more than half the potatoes produced in the State of Colorado. For more than a decade shipments have ranged from 4,000 to 7,000 carloads each year, and the gross receipts of the farmers have been from $500,000 to $1,250,000.

Aside from Denver and the mountain towns, the main markets are in Texas and Oklahoma. Many potatoes are shipped to Kansas and Nebraska, some to Memphis and other river points, and in case of

partial failure from rot or other causes in other States, as notably in 1903, considerable quantities to Chicago, and even to Boston and New York.

There are other localities in the State, notably in the "divide region" south of Denver, and in the mountain valleys and parks, where potatoes are grown without irrigation in considerable quantities. But in the Greeley district this is impossible to any extent even in years of greatest rainfall. It is a curious fact that, while most growers at Greeley incline to the theory that growing potatoes on sandy ridges, and with no more water than is absolutely necessary, gives the best quality in the tuber; yet, on the other hand, it is hardly to be questioned that the potatoes grown in any of the other localities named will not compare, either in yield or quality, with the potatoes grown at Greeley.

IRRIGATION AND ALFALFA AS FACTORS OF SUCCESS.

During the first or experimental years in the business a number of conditions prevailed which do not now exist on the older cultivated farms. There was in Colorado from 1870 to 1875 no forage plant adapted to upland cultivation. Red clover had been tried, but had not succeeded; timothy also, but its bulbous roots had proved too toothsome to the grasshopper. Alfalfa arrived in 1873, but had not yet come into general use, and its potentialities for lightening up and fertilizing arid soil were unknown and hardly suspected until a much later date. One of the first things discovered when the settlers began to break up, irrigate, and cultivate the upland soil in Colorado was that they could neither successfully irrigate a planting of potatoes or corn to bring it up in case of an insufficient rainfall to germinate tuber or seed, nor apply water during the earlier stages of growth without endangering the aftergrowth and ultimate yield of these crops. If, after planting, the usual rains failed and water was applied, there almost invariably resulted a poor stand, and sickly, spindling, unhealthy vegetation even where the seed germinated at all. It was, in fact, for many years the belief of the best farmers, based on experience, that it also injured potatoes to irrigate them before they were in blossom, or at least until the vines were of sufficient size to shade the earth about the crowns of the hills. When, however, these farmers began to turn under alfalfa stubble, or growing fields of this wonderful plant, from 1 foot to 18 inches high, preparatory to the planting of a crop of potatoes, a change in conditions was quickly observed. Now, if the winter has been an unusually dry one, and virtually all moisture resulting from the irrigations of the previous season has been lapped up by the winds, the field to be devoted to potatoes can be irrigated before plowing it; or, having been barely able to plow the ground without irrigation, if the expected rains do not follow, the grower

proceeds with planting, and, if necessary, immediately furrows out the rows between the easily distinguishable lines left by the planter, and turns in the water. And this operation is almost invariably attended by success. Furthermore, if the late May rains, which can be depended on five years out of every six, prove in any instance only sufficient to sprout the seed and bring the young plants above the surface, there is no longer any hesitation to irrigate then or at any later period of growth when, in the judgment of the experienced farmer, conditions require it.

ROTATION OF CROPS AND SHEEP FEEDING.

Systematic rotation of potatoes with other crops, as well as the cleanest and most thorough cultivation, is practiced. The intensive farming or cultivation found in other parts of the United States, whether in the tobacco fields of Connecticut, the hop fields of New York, the celery trenches of Michigan, or the onion gardens and the cabbage patches around any of the great eastern cities, is not superior in any respect to that which is practiced on the potato farms around Greeley. In general, one or at most two crops of potatoes succeed the turning under of a three-year or four-year old alfalfa field. In some instances a second crop following the one on fresh alfalfa sod is found to yield even better returns than the first. A third, very rarely planted in succession, almost invariably results in a poor crop. After one or two crops of potatoes, therefore, following alfalfa, there usually follows a crop of wheat, and after wheat, perhaps barley or oats, and then with the second grain crop, and sometimes even with the first, a fresh seeding to alfalfa is made, and there follows another two or three years in hay crops. Corn is not cultivated to any extent in the potato area for two reasons: (1) Potatoes are a better crop to rotate with grain than is corn, and (2) we are so near the mountains that the nights are too cool for profitable returns in corn.

Sheep feeding has recently become quite an industry within the potato belt. The sheep utilize the alfalfa hay crop, which has been found by experience to be better adapted to fattening lambs for the market than any other forage plant, and the great quantities of manure from the feeding pens, being hauled back onto the fields, are found to enormously increase the yields. Heavy coatings of sheep manure in a measure postpone for a time the necessity of rotating with alfalfa. It has also been found that a light coating of manure turned under with the alfalfa sod will produce still heavier returns in potatoes than can be obtained by a heavier coating on wheat or other grain stubble to be plowed for potatoes.

USE OF MACHINERY AND METHOD OF CUTTING SEED POTATOES.

Every operation in potato cultivation, from planting to harvesting, is performed by machinery (Pl. XXXI). The planters in use are more perfect in their automatic action in dropping the seed than are any of the various machines for sowing or drilling grain, and the diggers, after years devoted to the experimental stage in their construction and application, do their work to perfection. Machines have even been used for cutting up the tubers into sections for planting, but for various reasons, some of them obvious, they have not been successful. The nearest successful approach to the use of a machine for this purpose is a method of cutting now quite generally employed. A wide bench is boxed in on the ends and one side and divided into two or three compartments, all open in front. To each of these compartments is attached a sack on hooks, and along the open side of the bench in the middle of each compartment is fixed in an upright position a shoe

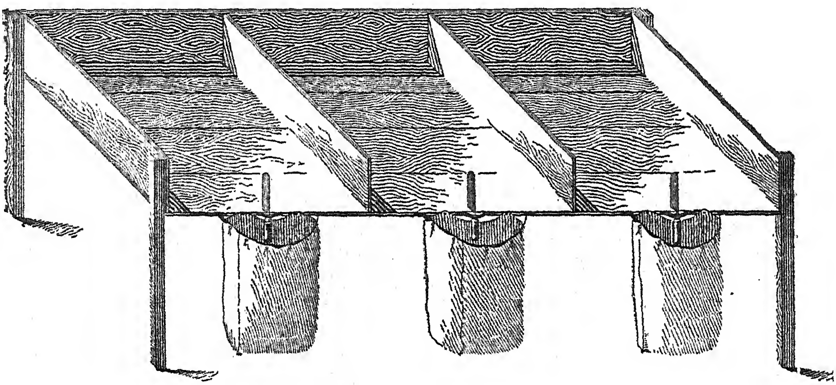
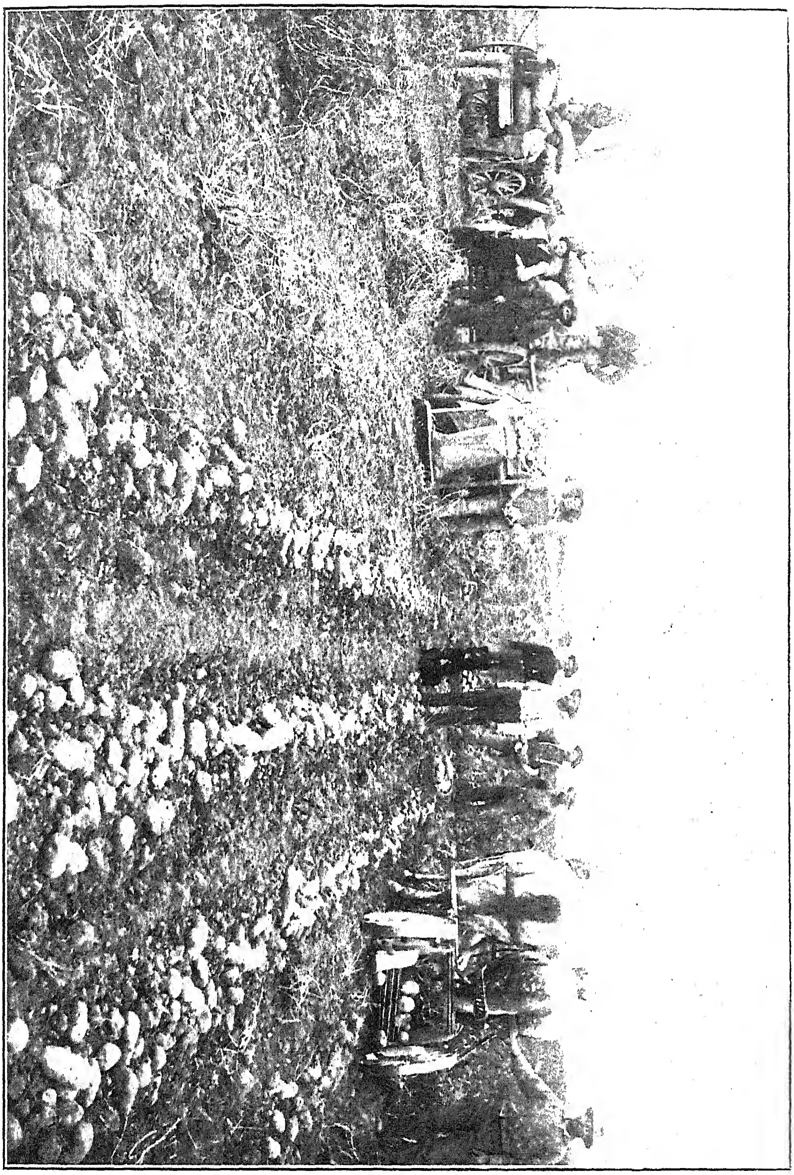


FIG. 27.—Bench for cutting seed potatoes.

maker's knife or common steel table knife (fig. 27). Onto this bench are then shoveled the potatoes to be cut for planting, and in front of each compartment a man takes his position on a box or stool. He seizes the tubers in rapid succession and by pulling them against the blade quickly cuts each one into two, or four, or eight pieces, according to its size, the pieces being then dropped into the open sack. By this indirect method of using the knife two fairly good cutters will prepare each day all that is ordinarily required for one planter.

SEED POTATOES.

Great care is exercised in the selection of seed potatoes, and many experiments have been tried by farmers to determine the best size to be planted. But it has never been satisfactorily demonstrated that a large potato is better for seed than a small one, or that a whole potato is



DIGGING, SORTING, AND SACKING POTATOES IN THE FIELD.

better than a piece containing one or more eyes. A whole potato will maintain its vitality for a longer period in dry, improperly prepared soil, and under these adverse conditions such seed will result in a better stand, but otherwise we have never been able to discern any advantage resulting from the use of whole rather than cut tubers, or of large pieces rather than smaller ones. Consequently, after many years of experience and close observation in the business of growing potatoes in this region, our farmers almost invariably use small potatoes for planting purposes. In fact, they care very little how small the tuber may be if it is perfect in form and true to type. A very small potato is sometimes planted whole, but is more often cut into halves; the next size above it is cut into quarters, while the potato that is just below the shipping size is usually cut into eight pieces.

The words "true to type" may require explanation. For some reason that the growers are unable to explain, the best varieties obtained from other regions and constantly brought here to replenish or entirely replace our own, manifest from the very first year's planting a tendency to "run out," as we term the process of degeneration, and to revert to the forms of the original tuber from which we presume all our modern improved varieties were derived. A round or slightly flat and oval variety with smooth surface and very few eyes in proportion to its bulk will, under this degenerating process, soon produce a large percentage of long, rough potatoes covered with knobs or irregular protuberances and thickly studded with deep-set eyes.

The smaller-sized potatoes so generally used for seed are from that portion of the crop which drops through our coarser-meshed screen in sorting and sacking for the market. That is the first process of elimination, and the next is very carefully performed by hand. Every one of the malformed, deformed, degenerate tubers is thrown into the waste basket always sitting near at hand. In connection with this very important subject of seed potatoes another singular fact may be mentioned. It would most naturally be inferred by a novice in the business that in a locality and under a system of cultivation which produces such large yields of potatoes of such superior quality excellent varieties might be originated. This was the general belief at Greeley until the experiment was tried thoroughly and repeatedly, not only by private parties, but in the most careful and painstaking manner by the agricultural experiment station at Fort Collins. Nevertheless, out of hundreds of new varieties so originated, and out of dozens that, even after a second or third experimental planting, seemed to promise extraordinary results, not one has been found worthy of general cultivation for the market.

METHOD OF GROWING.

PREPARATION OF SOIL.

At Greeley the soil is plowed deep for the potato crop. As a rule, three to four large draft horses are used with a 14-inch or 16-inch walking plow and from four to six with a sulky plow. Little fall plowing is done in the potato region, for the reason that, as a rule, the soil is too dry at that season, and there is seldom water in the fall with which to irrigate.

PLANTING.

The ground having been plowed and thoroughly harrowed, and the season for planting having arrived, while two or more men are engaged in the potato "dugout" cutting up seed, the planter is at work in the field. With two horses attached, perhaps 5 acres per day is the average for each machine. Occasionally, on the larger farms four horses are attached to the planter, and by this means the area planted may be increased to 7, 8, or 9 acres per day. The planters are so constructed that they may be regulated to drop single pieces very accurately at distances of 9, 12, 15, or 18 inches in the row, according to the choice of the farmer, this depending in some measure on the variety planted, but more on the condition of the soil. Of course, a heavily manured or otherwise very rich field will stand closer planting than a poorer soil perhaps on another part of the same farm and still push a majority of the tubers to a marketable size. The distance between rows varies from 3 feet 6 inches to 4 feet. The closer planting sometimes seen in other States is not practicable here for three reasons: (1) We use the standard cultivators of the corn region; (2) the heavy growth of vines usual with a good crop impedes the flow of water in irrigation; and, (3) a good, clean-cut furrow being essential in all but sidehill irrigation, it is impracticable to plant within narrower limits than those indicated.

The season for planting begins about May 20 and ends with the first week in June. Few potatoes are planted later than June 1 and not many before May 20. A comparatively small acreage is annually planted in early potatoes, but the yield nine times out of ten is very light in proportion to that of later plantings. This difference probably results from the fact that the main growth of the tuber in the earlier plantings necessarily takes place in June, the driest month of the growing season. This view is supported by the fact that the seasons of greatest success with early potatoes are those in which there is an unusual quantity of rain in June. At all events, yields of potatoes from April and early May plantings as a rule average only from 30 to 50 sacks of marketable potatoes to the acre, while the yield from later plantings ranges on good farms from 75 to 200 sacks. A sack holds from 110 to 120 pounds, according to the skill shown in stuffing the sack.

CULTIVATION.

Cultivation follows planting very closely. In fact, on large farms and where plowing has preceded planting any length of time or when heavy rains have intervened between plowing and planting, it is quite common to see the cultivator at work on one side of a field before the planter has retired from the other. The planter opens a narrow furrow before the dropper, and the two indrawing shares cover the seed, leaving a plainly discernible ridge. It is, therefore, even more feasible to cultivate a field immediately after planting and before the crop is up than a little later, when the plants are all in sight and care is necessary to prevent covering them or breaking off the young plants. The potatoes are cultivated from three to five times, according to the season and rainfall, or the application of water, and until the vines so cover the ground between the rows that it is no longer practicable to get through them with cultivator and team. After each irrigation, or after any heavy rainfall that may occur, the scientific irrigator and potato grower sets his cultivators at work just as soon as the condition of the soil will permit, no matter how recently he has gone over the field.

IRRIGATION.

If rains occur after planting sufficient to bring up the crop and carry it well forward in the season, it is preferable not to use water until the vines shade the ground and are in blossom and the tubers are beginning to set. But, as before stated, rainfall is not relied upon to bring the crop up to this stage, and whenever conditions seem to require it, whether to sprout the seed or to supply moisture necessary for steadily continued growth, water is turned on. And whenever it has been necessary to begin using water, if it can be prevented, the soil is never allowed to become thoroughly parched and dry from that time on to the end of the growing season. Experience has shown that a field of potatoes, having once been stimulated by the artificial application of water, must be watered at frequent intervals to prevent a setback in growth, and that a check in the growth of either plant or tuber after one or more irrigations is more injurious by far than if the plant had in the first place been considerably pinched for the want of moisture.

The conditions under which irrigation should take place have been stated in general terms, but it would be difficult, if not impossible, to indicate to a novice through written directions just when the conditions actually exist; for instance, the absence of moisture after planting to such an extent that the sprouts will never get up through the dry earth is a matter that only actual experience can determine; and there is the early period of growth when the vines for lack of moisture get, to use a common expression, "black in the face," come almost to

a standstill, and irrigation is required to insure steady and continued development of vine and tuber. Here again knowledge can be obtained only after long observation and experience. Irrigation is applied early and late, as the conditions require, as before stated, and, except with the comparatively small area devoted to early potatoes, the season ends in all ordinary seasons only with the first week in September, and sometimes even later.

Formerly, and before the construction of reservoirs to furnish an additional supply of water for late irrigation, potatoes were irrigated three or four times in the season, according to the supply of water, which was usually insufficient and precarious. Now the crop is irrigated from four to ten times, depending on the character of the soil and the rainfall, the latter always in the Greeley section an uncertain quantity. By this more liberal use of water than was for a long time deemed necessary the average yield of potatoes has been more than doubled within the past ten or twelve years.

An ideal application of water to a growing potato crop would require that the water should never rise above or stand around the base of the plants at the crown of the ridge or hill. This is, however, impracticable in general cultivation. With very short rows and a very even slope, such as seldom exists on average farms, it would be possible to approach this ideal, but as a matter of fact very little attention is generally paid to the matter. There is always but a given quantity of water, and the question with the farmer is usually how to apply it to the best advantage in getting over his field in the shortest time compatible with the best results. To that end he divides his water into just as many furrows as it will fill sufficiently to make it flow off rapidly down the slope. He is careful by means of cross laterals not to run the water too great a distance without change, because that would waste both time and water. Then he depends on prompt and thorough cultivation to prevent the ground from baking about the vines when they are small, where the water will inevitably in places back up and break over the ridges.

MECHANICAL DEVICES AND METHODS OF APPLYING WATER.

Various devices to facilitate distribution and several methods of application are in use at Greeley as elsewhere in all irrigated regions. Winged shovel plows (fig. 28), corn listers, and double-moldboard plows (fig. 29) of various designs and makes are used to open the furrows for carrying water between the rows. The common plow is often used to turn a right and left double furrow for larger sublaterals for the conveyance of water along the margins of fields, the plow being sometimes followed by what is known as a wooden V scraper, with a tongue attached to displace the loose earth and clean out the ditch. Sometimes

the shovel only is used to clear the ditch bottom after this double plowing with a common plow. A better implement, and one quite generally used in all the section about Greeley, consists of a double-moldboard plow some 2 feet or more across its bottom from tip to tip of its shares (fig. 30). This, drawn by 2 to 6 horses, makes an excel-

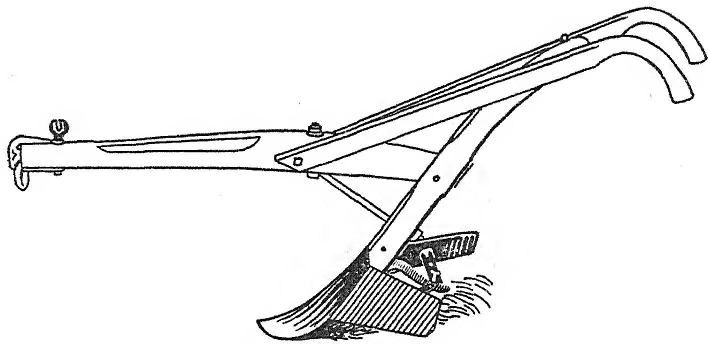


FIG. 28.—Winged shovel plow for furrowing out.

lent lateral for conveying water through or across fields of any crop, whether grain, alfalfa, sugar beets, or potatoes.

Not the least useful of all the devices used in aid of irrigation is the canvas dam (fig. 31). This consists of a piece of heavy canvas from 3 to 5 feet long and from 4 to 8 feet wide, according to the size of the

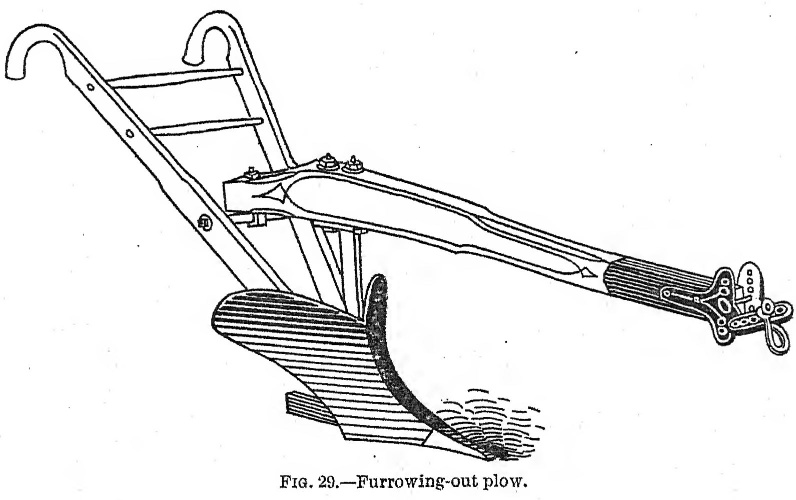


FIG. 29.—Furrowing-out plow.

different laterals in which it is to be used. This may be nailed to a stout pole for the larger sizes or an old hoe handle or other stick for the smaller dams, or a wide hem may be sewed on one edge lengthwise of the canvas and the pole or stick inserted. Such a device placed in the smaller interior laterals or even in the larger supply laterals across

margins of fields, with a little dirt placed upon the lower edge of the apron formed on the bottom by the canvas, the top edge being sustained by the pole or stick placed across the lateral from bank to bank,

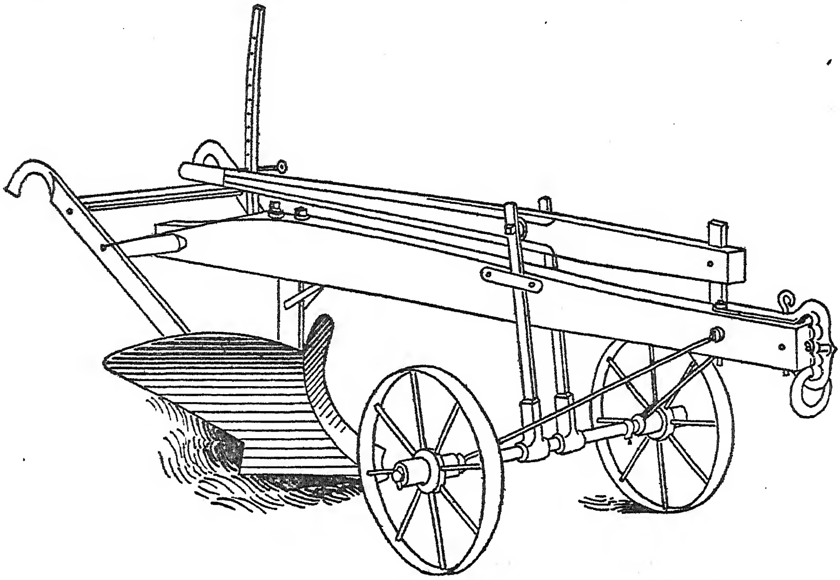


FIG. 30.—Lateral plow.

constitutes a most effective dam, which will remain temporarily in position while in use even more securely than a dam made of loose earth.

In the irrigation of potatoes the ground is furrowed out with one of the plows described above, the supply lateral is constructed across the upper edge of the field to be irrigated, and, if the field is very large, along the margin also, parallel to the rows down one side and across the middle at a lower point (fig. 32). The irrigator, with a shovel and several canvas dams, perhaps of different sizes, begins at the upper end and at the highest corner of the field, and placing a dam in the sublateral at a distance of from 3 to 12 rows from the corner, carefully places two or three shovels of dirt upon the flap to hold it in position when the water strikes it. Then, having raised the gate in his main lateral not far distant, he lets in his supply of water, which, passing at once down the sublateral to the canvas dam, strikes it and comes to a stop, and after settling its sides and bottom

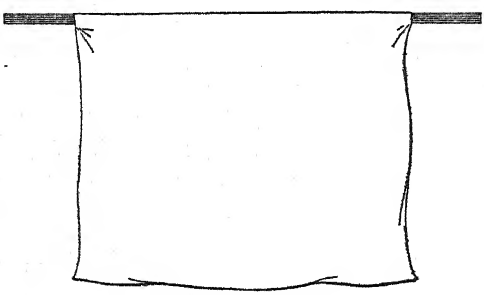


FIG. 31.—Canvas dam.

firmly against the ditch surface all around, rises, backs up, and begins to flow down the furrows, the ends of which the irrigator has meanwhile opened with his shovel. In a small field of from 10 to 20 acres, or even in a much larger field, where the fall is great, the water turned in at the top of the rows, as here described, will flow through the entire length without a change; but in larger fields of from 40 to 160 acres, very common at Greeley, that would be impracticable. It would be a waste of both water and time, besides being likely to result at times in injury to the crop. It is therefore usual to have one or more cross

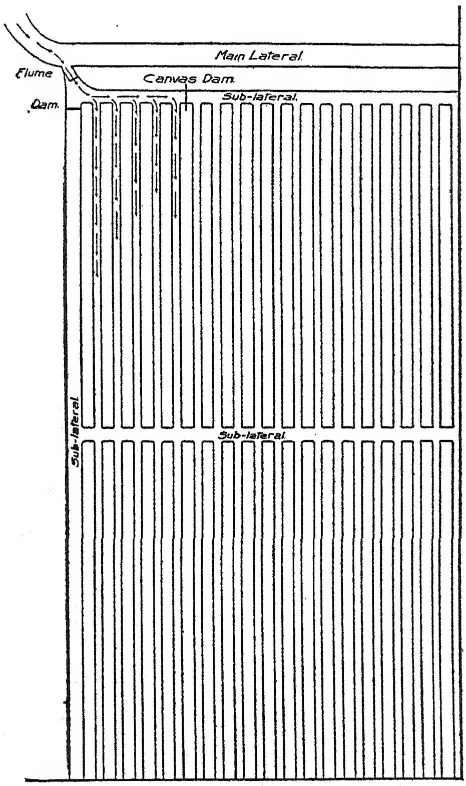


FIG. 32.—Plan of potato irrigation.

laterals plowed at intervals down the field. Having carefully noted the progress of the water down his first set of rows until it reaches their ends below, or the first cross lateral, perhaps midway of the field, the irrigator now places a second dam farther along in his first lateral, so as to take in from 3 to 12 more rows, according to his supply of water; he then opens their ends, and taking out the first canvas dam lets the water down with a rush to the second, after which he immediately closes the mouths of the first set of furrows with dirt. Thus, he continues across the first or upper section of his field until in turn all the

rows have been thoroughly irrigated. If the size of the field has made it necessary to open one or more cross laterals, he then diverts his entire supply of water down the lateral at the side of his field, and, having previously placed a canvas dam in this side lateral at its point of intersection with its first cross lateral, he repeats his first operation by placing another dam in position to take the water into from 3 to 12 rows at the new point of intake, and so proceeds until the irrigation of the whole field is complete. Various modifications of the plan here described are practiced on rough sidehill farms, or where for other reasons it is not entirely applicable. But the method outlined will in general fairly illustrate the system in use in the potato, corn, and beet fields.

Although potato cultivation is practiced in different localities in the older States on even a larger scale than in the vicinity of Greeley, yet there are comparatively few farmers in this country who have ever seen 160 acres, or even 80 acres, of potatoes in a single field. Such areas are by no means the rule at Greeley, but a block of 20 acres is regarded as a "small patch," 40 acres is but a usual field, 80 acres is not uncommon, and a quarter section in one solid square not unknown. And in a country where the lines of demarcation are so distinct between aridity and irrigation that on one side of a ditch all is the greenest of verdure, while just across it and only a few feet away all is as brown as the Sahara, there are few more pleasing, inspiring sights than one of these large potato fields when in full blossom.

PRACTICAL ROAD BUILDING IN MADISON COUNTY, TENNESSEE.

By Sam C. Lancaster,
Chief Engineer Madison County Good Roads Commission.

The purpose of this article is to give the plain facts relating to the construction, cost, and maintenance of first-class stone roads in a county of west Tennessee, where it was necessary to transport all material by rail; and in order that the reader may be able to comprehend these facts more fully, a few statistics are here given regarding area, population, taxable values, etc.

FACTS ABOUT MADISON COUNTY.

Madison County is situated in the central part of west Tennessee, on the plateau slope above the Mississippi Valley. Jackson, the county seat, is located approximately in the center of the county.

The census of 1900 gave the population of the county as 36,333, and of the city of Jackson as 14,511, although from a recent school census the population in the county is now estimated at 41,135, and conservative estimates place the population of Jackson at from 19,000 to 20,000.

The county has an area of 512 square miles, or 328,091 acres, with an assessed valuation of $1,942,925, an average of $5.92 per acre. In the city of Jackson there are 3,111 blocks, with an assessed value of $2,543,553, besides an assessed value of personal property amounting to $705,955. The assessed valuation of railway, telegraph, and telephone companies in county and city amounts to $954,368.64, upon which there was collected in 1904 an ad valorem tax of $3,331.66. Thus, it will be seen that the total assessed taxable values in the county amount to more than $6,000,000.

The tax rate paid by residents of Madison County for State and county purposes is $1.12 per $100 of assessed valuation, which assessed valuation, however, is very low.

Of this tax, 12 cents is for the payment of interest on the good-roads bonds, of which $300,000 has been authorized and $150,000 issued.

It will be seen that, when the remaining $150,000 is issued, a slight increase in the rate may be necessary to meet the interest, but this will

not exceed 5 or 6 cents on each $100 of assessed valuation. Moreover, with the rapidly increasing values, the rate of taxation will be reduced in a few years to the present rate or even below it.

THE INCEPTION OF THE WORK.

The spring of 1888 found Jackson, Tenn., a country town with a population of less than 10,000, and only mud streets.

The Illinois Central Railway Company placed two coaches at the disposal of the city council and some dozen or more representative citizens, and invited them to become the guests of the company for a visit of ten days to the cities along its northern and western lines. The citizens returned from the trip with the determination to at once improve the conditions of their own city, and began by constructing a system of sewers and other public improvements. Subsequently, they proceeded to macadamize all the principal streets.

PRELIMINARY INVESTIGATIONS.

The improvement of the streets of Jackson led to a desire to better the condition of the country roads, although nothing was accomplished for several years. Three of the main roads crossed a river valley near the city limits, and these are popularly known as "levee" roads. It had been the custom to plank these levees in order to render them passable during the winter months. Through the Young Men's Commercial Club of Jackson, the writer was requested in the fall of 1893 to submit some facts to the county court. As a result, it was shown that the first cost of such planking was greater than that of macadamizing, while, in durability, the wood could not be compared to stone. It was urged that, if stone were used, it would serve to educate the people who traveled these roads, and subsequent facts have proven this to be true. The first stone was laid on these levee roads in 1894, and the cost of repairs on the first road improved has been less than $500, or less than $33 per annum per mile.

GOOD ROADS CONVENTION OF 1901.

Although the macadamizing of these levee roads proved highly satisfactory, and those interested in better roads sought by every means to extend the system, nothing was accomplished until June, 1901, when a good roads convention was held in Jackson, extending through one week. Governors from adjoining States were invited to be present, much interest was aroused, and many prominent men addressed the meetings. The Office of Public Road Inquiries of the Department of Agriculture sent representatives to direct the building of a piece of exhibition road; Mr. M. O. Eldridge, of that Office, gave an instructive lecture, with stereopticon views. Ten carloads of stone were contributed, and 1,000 feet of exhibition road was built.

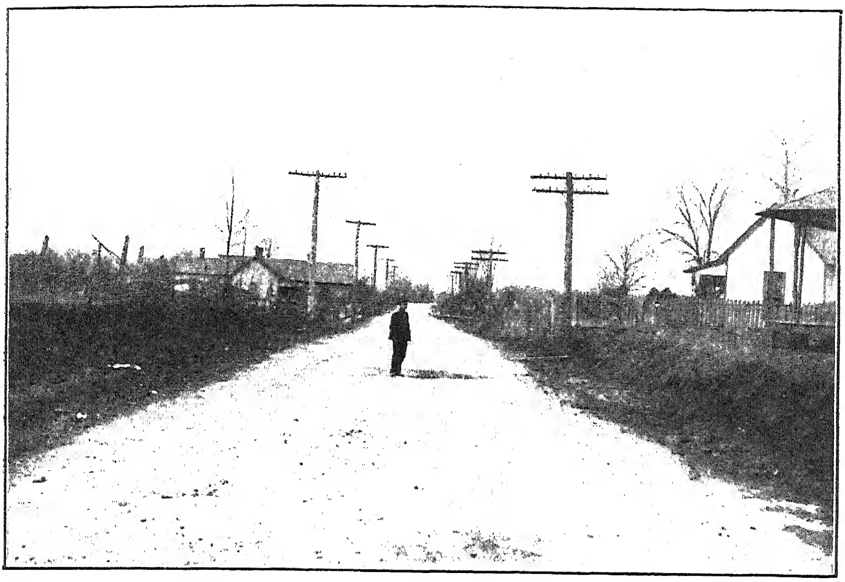


FIG. 1.—POPLAR CORNER ROAD, BUILT JUNE, 1901.
[This portion of the road was built of rounded water-worn material and is in bad repair.]

FIG. 2.—POPLAR CORNER ROAD, BUILT JUNE, 1901.
[This portion of the road, built of novaculite, has received no repairs and is in perfect condition.]

The Mobile and Ohio Railway gave five carloads of gravel, which came from Tishomingo County, Miss., and also donated the freight on five carloads of Novaculite rock from quarries located on its line, some 30 miles north of Cairo, in Alexandria County, Ill. The Illinois Central Railway and the National Good Roads Association supplied a train-load of modern machinery and tools, which were used in addition to the steam roller and road tools owned by the city of Jackson. The Illinois rock was extremely sharp and angular, and was delivered screened into three sizes; and it was laid in the usual manner, which will be fully described later. The Tishomingo County gravel was water-worn and somewhat rounded in form, and while it bonded well it did not produce such good results, as may be plainly seen by comparing the two figures of Plate XXXII, showing the road after it had been in use three and a half years. The material was put down at the same time, on the same road, with equal care, and in the same manner. One material was angular, sharp, and properly screened for use, making an ideal road, while the other, water-worn, rounded, and not screened, soon went to pieces.

Although this object-lesson road was built in June, 1901, it has had no repair whatever; the side ditches have not even been cleaned, and it has been subjected to heavy travel. All the stone used in extending this road a distance of 2 miles during the past summer was hauled over the road, some of it by traction engine during extremely dry weather, yet, on that part built of novaculite, the surface is practically perfect.

MASS MEETING OF 1903.

The enthusiasm created by the good roads convention and the construction of the object-lesson road served a most valuable purpose, but time was required for the facts to be digested, and the process was greatly hastened by the "winter of great mud," 1902–3. When it came, the burden could no longer be borne—the roads were impassable; it required two strong mules to draw a milk wagon with two milk cans, and all day was consumed in going a few miles. For more than six weeks this condition prevailed. No one attempted to pass over these mud roads except in case of dire necessity. The farmer was locked in and all trade was stopped. The opportune moment had arrived; a mass meeting of all the citizens of the county was called, and those who could get to it came. All wanted good roads, the only difference of opinion being as to the best means for procuring them, and after a long discussion which seemed likely to prove disastrous, some contending for a direct tax and a few roads each year, and others wanting to issue bonds, a farmer arose and addressed the meeting as follows:

Mr. Chairman, I am just a plain farmer and have no business trying to talk in this meeting. I am all covered with mud; there is mud on my boots, and all over my

clothes, and my hat is all spattered up, too. I walked to this meeting because my horse couldn't travel the roads. I've got a little farm and sawmill out on the Poplar Corner road, just a little over 2 miles from town, and if I could climb up on a hard road with my truck and what lumber I've sawed, I could clear enough in one day to pay my tax on that road; but I haven't got it.

I bought some groceries from you [turning to a merchant] this month; yes, $5 worth, for I carried them out on my back; but if I had a good road, it would have been $25, I am sure.

This plain statement brought the question home, a hearty laugh went round, and a motion prevailed, without opposition, to instruct our representative in the State legislature to draft a bill authorizing our county court to issue bonds in the sum of $300,000, bearing 4 per cent interest, and extending over a period of thirty years.

LEGISLATION SECURED.

The bill immediately became a law. It provides that the first $150,000 shall be used in the construction of roads within a radius of 5 miles from the corporate limits of the city of Jackson, and the second $150,000 in the construction of roads within a radius of 10 miles from the corporate limits. The first issue was sold at par. The writer was chosen as chief engineer to direct the construction of the roads, and work was begun in June, 1903.

ORGANIZATION AND PLAN OF OPERATIONS.

The county court is composed of forty-four magistrates, each district having two representatives, except the district in which Jackson is situated, which has eight. This being rather a large body, the court, in order to facilitate matters, created a commission known as the Madison County good roads commission, in whose hands it placed all authority possessed by it for the construction of a system of improved roads.

This commission is composed of five representative men, members of the county court, residing in different parts of the county; the chairman of the county court is also by reason of his office a member of this commission.

The funds are held in trust by the good roads bonds trustees, under whose direction the bonds are sold, and to whom all moneys are intrusted. The funds are deposited equally in the five banks of the city, and the board of trustees is composed of one representative from each bank, together with the chairman of the county court.

The execution of all work and the purchase of all tools, materials, etc., are under the direction of the chief engineer and the good roads commission. Proper vouchers are issued by the chief engineer in payment for all bills when properly countersigned by the secretary of the

good roads commission and two of the bonds trustees, who constitute the finance committee, and then by the secretary, who is the chairman of the county court, and who issues the checks. The funds are thus safeguarded and kept in a businesslike way.

MATERIALS AVAILABLE FOR ROAD BUILDING.

The situation of the county and its geological formation are such that no material suitable for road building has been found in the county or its immediate vicinity. Beginning in northern Alabama and extending through the northeastern part of Mississippi, thence through Tennessee, following closely the Tennessee River through western Kentucky, crossing southern Illinois and Missouri, then down through the State of Arkansas and out into Indian Territory there is found a rock commonly called "chert," and known in Illinois as novaculite.

This material seems to have been prepared in nature's laboratory especially for road building. As it stands in the quarry, it has innumerable cracks and seams which are filled with a fine material of high binding power. The use of dynamite or powder is required to throw it down, whereupon it breaks into irregular forms with very sharp edges.

The material first used by the city of Jackson came from the Tennessee deposit, about 48 miles east of Jackson. A large quantity of it was used on the city streets, and the three levee roads spoken of were paved with it. The material was not screened, and the large pieces of stone had to be broken with hand hammers, requiring considerable care and expense to insure its being well done in order to prevent large pieces from working to the surface, as they will always do in time, to the great detriment of the road.

In the spring of 1898 the city wished to improve certain streets, and on inquiry found that no material could be procured from the Tennessee quarries, because the railway companies were ballasting their tracks; hence it became necessary to look elsewhere. Bids were received for material from Tishomingo County, Miss., as well as from the Illinois quarries. There being but little difference in the bids, and the Illinois material being screened and furnished in three sizes, the latter proposal was accepted. Since that time the city has secured practically all the material for paving its streets from this source, but the county uses some material from the Tennessee deposit also.

The city streets are kept in good repair, at comparatively small cost, and this is done under the direction of the writer, as city engineer. Some of these streets have been in use for five years without any repairs whatever, and are still in excellent condition.

COOPERATION OF THE RAILWAY COMPANIES.

Without the hearty cooperation of the railway companies, the construction of stone roads in this county would have been so expensive that it could never have been accomplished.

The Nashville, Chattanooga and St. Louis Railway Company delivered this material on board cars at Jackson for $1\frac{8}{10}$ cents per 100 pounds, with a haul of from 43 to 50 miles, while the Mobile and Ohio Railway Company, with a haul from Alexandria County, Ill., of 130 miles, pays the Illinois Central Railway Company's bridge toll over the Ohio River bridge at Cairo and delivers this material on board cars at Jackson for $2\frac{3}{4}$ cents per 100 pounds. It should perhaps be explained that in securing this last-named rate the attention of the company was called to the fact that large shipments of lumber from the pine forests of Mississippi and Alabama were made daily to northern points during the summer months (which is the season for road building). These cars were returning empty, and, as the officers of this company had for a long time advocated the building of good roads, they consented to name a rate which would allow these empty cars to return to us loaded with stone.

LOCATING THE ROADS.

Before starting any construction work a complete survey of all the roads within a radius of 5 miles was made, maps and profiles were prepared, and, where changes in location seemed advisable, these were projected. After a careful consideration of cost, grades, and alignments the best routes were selected; and so far as possible the plans thus formed have been executed. It is a sad fact, however, that engineers and commissions may propose, but county courts dispose.

Straight lines and easy grades may be laid out on paper so as to avoid many a winding way or an awkward turn; you may seek "to remove mountains" by curving around their bases, but, if Bill Jones or Tom Smith is left on the old road, trouble ensues, sympathies and jealousies are aroused, and every man who ever traveled that winding road becomes an ardent admirer of its steep hillsides and devious course; and, cost what it will, the engineer receives peremptory orders to "stay in the old road." There have been exceptions, and some important changes have been made in order to shorten distances and avoid steep hills, but in almost every case we have had to pay excessive rates for rights of way, and sometimes to resort to condemnation procedure.

Two changes were projected, but never made, which would have greatly improved the alignment and removed four long grades having a vertical ascent of 14 feet in each 100; in one case the new road would have traversed a valley route, fulfilling all the requirements of two hill

roads for a distance of more than 2 miles (fig. 33), and, although the saving effected would have been more than $12,000, the opposition

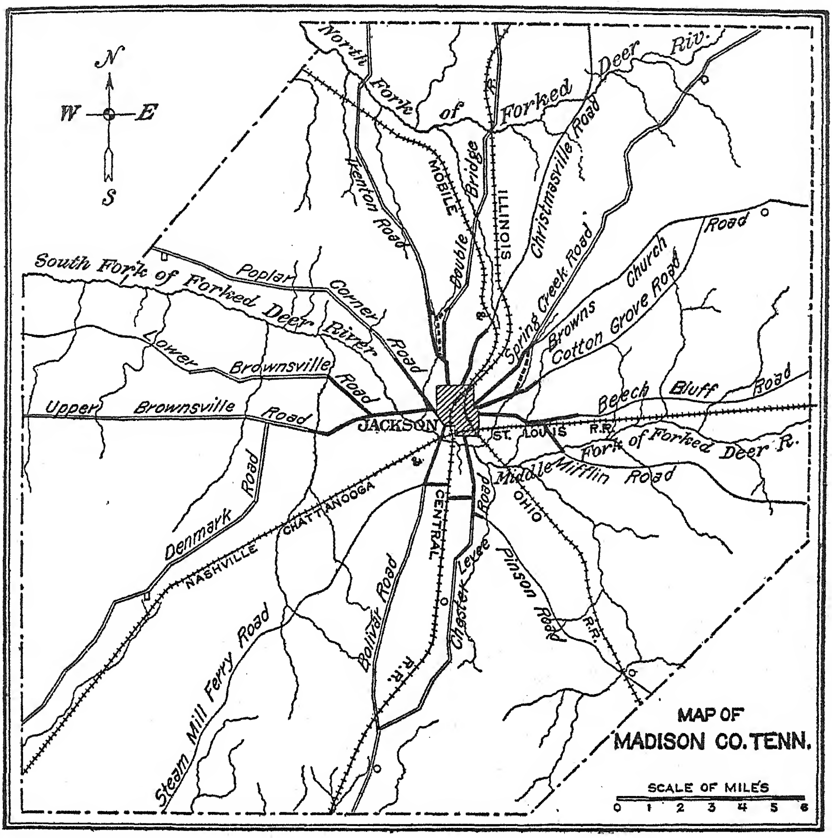


FIG. 33.—Road map of Madison County, Tenn.: The heavy black lines show roads that have been macadamized; the double lines show the more important roads not yet improved; the broken lines show where new alignments were proposed, which would have effected a saving of more than $12,000, had they been accepted.

was such that we "staid in the old road," and made the best of a bad proposition.

LABOR EMPLOYED.

All work is done under the immediate direction of the chief engineer, assisted by a competent corps of men in the field, who properly execute the work in its several branches. Hired labor has been used throughout, with the exception of a small prison force under the control of the county workhouse commission. Many other localities have used their prison labor in the construction of permanent roads to very great advantage; and it is possible to have this force do the greater part of the work of grading roads and unloading the stone, and in some cases the work of quarrying, crushing, and screening the

rock. No contracts have been let, except for tools, machinery, stone, and such other materials as are necessary. The laborers are almost exclusively negroes.

CONSTRUCTION OF THE ROADS.

A road, like every other piece of human work, is good or bad just in proportion to the amount of skill and ingenuity that has been used in its construction and maintenance.

Many inquiries are received regarding the method of constructing the roads in Madison County, and, in order to impart a more adequate idea of the system used, illustrations showing different stages of the work from start to finish are given. Figure 34 shows standard cross

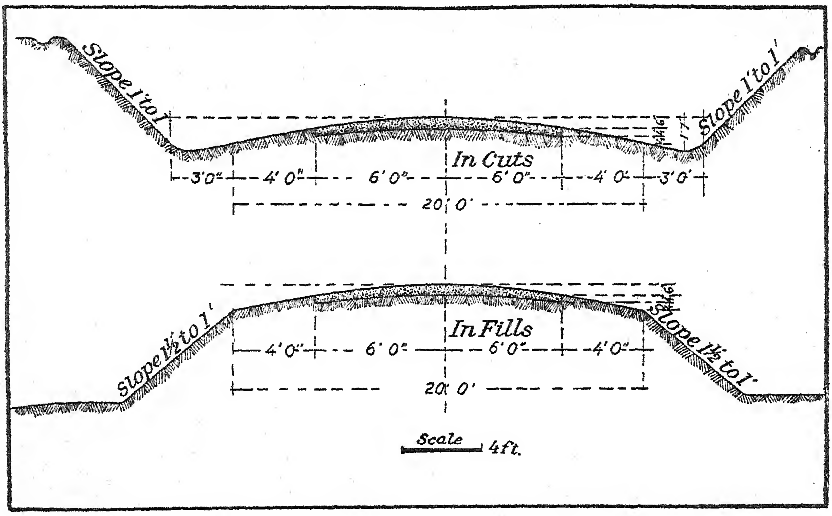


FIG. 34.—Standard cross sections of finished road.

sections of finished road. Plate XXXIII, figure 1, shows an old road as it appeared April 15, 1904. The clearing in the distant woods indicates the location of the new road. At this point the road was straightened and put on better ground..

The grading of the road having been completed and rolled with a steam roller, Plate XXXIII, figure 2, shows the force at work preparing the road for the reception of the first course of stone. It will be noted that the road machine in the distance, which is first used, and which rounds the dirt to the center, is being followed by a small force of laborers, who dress the surface accurately to lines.

The road is again thoroughly rolled with a steam roller, as shown in Plate XXXIV, figure 1, until the surface no longer yields; all the depressions are filled with earth as they appear, so that when the road

FIG. 1.—THE EVOLUTION OF A COUNTRY ROAD—1. APRIL 15, 1904.
[At this point the road was straightened and placed on better ground.]

FIG. 2.—THE EVOLUTION OF A COUNTRY ROAD—2. MAY 18, 1904.
[Finishing up the grade of the newly opened road.]

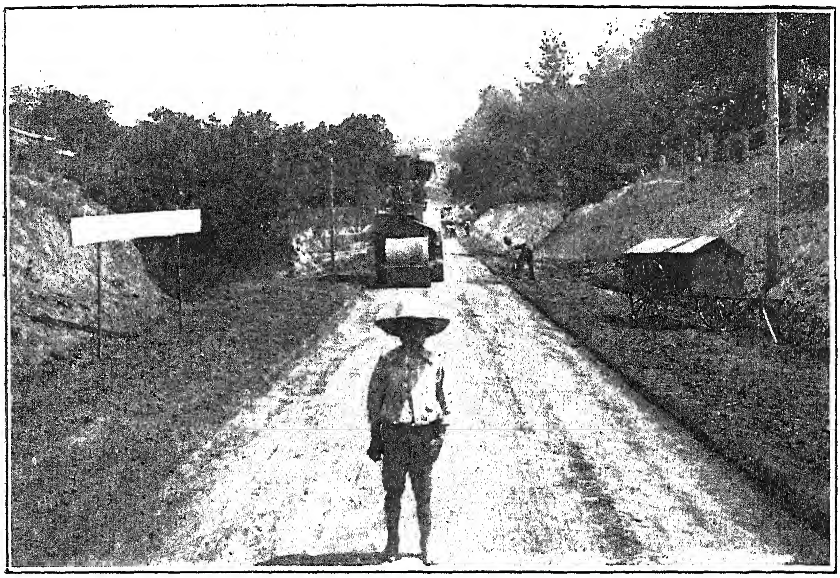


FIG. 1.—THE EVOLUTION OF A COUNTRY ROAD—3. MAY 18, 1904.

[Rolling the grade with the 10-ton steam roller.]

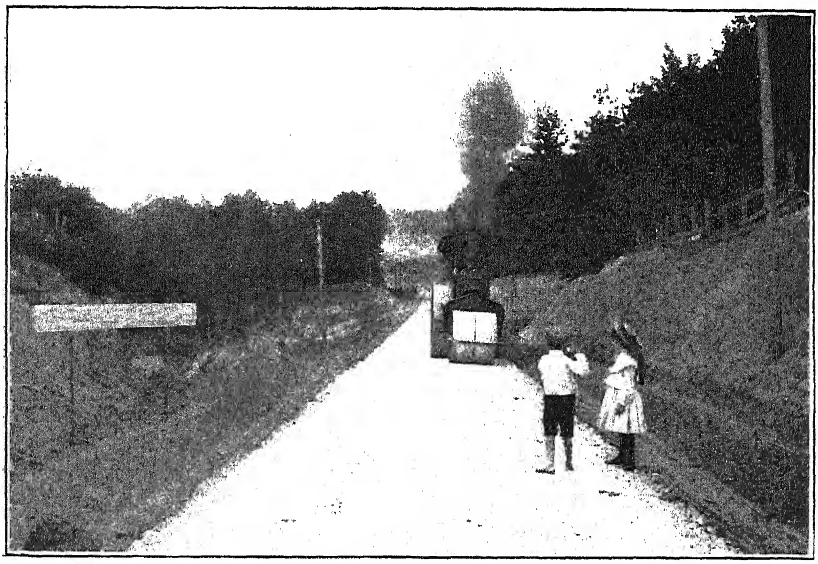


FIG. 2.—THE EVOLUTION OF A COUNTRY ROAD—4. MAY 19, 1904.

[First course of stone, 4 inches thick, applied; now being rolled.]

is ready for the stone the foundation on which it must rest is as solid as it is possible to make it. In all constructions men have learned the importance of solid foundations. If a road is to resist the wear to which it is subjected, the greatest care must be used in securing the best possible foundation.

The first course of stone, about 4 inches in thickness, is then applied (see Pl. XXXIV, fig. 2). It is of a size that will pass through a 3-inch r.ng. The stone is wet before rolling, the general practice being to sprinkle it thoroughly by means of a portable tank or wagon sprinkler of the type commonly used on city streets. This, however, has been found expensive, especially during extremely hot weather, as the water evaporates rapidly when sprinkled on the hot stone, and it is difficult to haul a heavy tank of water over this coarse, loose material. Therefore, it was arranged to wet each wagon-load of stone as it passed out to the road. If hauled from the city, a convenient hydrant is used. In other cases a running stream is utilized. Where no other source of supply is available, a 3-inch well is bored, sometimes having a depth of as much as 150 feet, and, with the aid of a portable gasoline or hot-air engine of, say, 2-horsepower, all the water necessary is supplied to properly wet 400 cubic yards of stone per day, and also furnish water for steam roller, teams, etc., at a cost not exceeding $2 per day.

In rolling the stone it should be remembered that it is best to first roll the edges and gradually approach the center of the road, as by this means the material is more thoroughly compressed and the crown is retained.

Having completed the rolling of the first course of stone, a second layer 2 inches thick, of a size which will pass a 1½-inch ring, is spread on as evenly as possible, being thoroughly wet and rolled as before. All depressions are then filled with the same material, and after rolling smooth, still another course is added, the material used being fine screenings, varying in size from that of a pea to the smallest particles. This last course is then wet and is rolled until the whole is thoroughly compacted and bonded into one concrete mass, having a thickness of 6 inches at the center and 4 inches at the sides. (Pl. XXXV, fig. 1.) Only a sufficient quantity of this fine material should be used to insure the filling of all voids and to properly bond the top course, a common error being to apply it unevenly or to an excess, which causes it to "pick out" in holes and wear badly.

Care must be taken to see that the road is properly ditched and drained, as no road can stand, however well it may be built, where the all-important question of drainage is neglected. An eminent authority has described a good road as "one with a tight roof and a dry cellar."

Some of the old Roman roads, built of heavy stone and mortar, have a thickness of 3 feet; but the best modern road builders have demonstrated that it is no longer a question of how much is put on, but how well it is put on.

Telford and Macadam dug sufficient stone from the old Roman roads throughout England and Scotland to entirely reconstruct them by the new methods of road building which have been accepted by the civilized world. They appreciated the importance of breaking the stone and placing it so as to cause the particles to wedge together. These eminent men lived before the introduction of our modern road machinery, which has done so much to facilitate the construction of roads as well as to increase their durability.

PHYSICAL TESTS AND BINDING QUALITY OF MATERIAL.

The material which has been used in constructing the roads of Madison County possesses most excellent binding qualities, which are so necessary to the life and quality of any road. While binding power is possessed by many materials, there are many instances where failures have occurred solely on account of the selection of material which, while possessing great hardness, would never bond. Extensive research has been made to determine, if possible, what really constitutes this natural binding quality, and many theories have been advanced. The Department of Agriculture has organized a Division of Tests, which is endeavoring to determine the exact nature of this important factor. Comparatively recent tests have developed the fact that with many rocks continued grinding while wet produces a higher cementing power. Microscopic examination reveals a substance very much resembling glue. The Division of Tests referred to has been created for the purpose of testing and reporting on the fitness of materials for road building, and will doubtless prove of incalculable service to road builders. By methods now well established this Division is able to say just what materials are best suited to road building in each particular locality, and in what degree they possess a "natural bond." The results of actual construction have proven the correctness of these methods. The use of a certain amount of water, and then pressing and grinding the particles together with heavy rollers, keeping continually at it until the road is solid and begins to dry, are essentials to success in making a good road which will have a "tight roof" and, if properly drained, will always have a "dry cellar."

BRIDGES AND CULVERTS.

As far as possible all waterways crossing the roads are made permanent. The small openings, up to 24 inches in diameter, are made of standard double-strength culvert pipe. From 24 inches up to and including openings 5 feet square, "reenforced" concrete constructions

are used; but as yet nothing larger than this has been built. Wooden bridges are used for the larger openings, and all are built to carry safely a load of 15 tons.

As reenforced concrete is rapidly coming into general use, a description of this construction should prove of interest. The spacing of the corrugated steel bars used and the thickness of the concrete are varied to suit the span and load, the concrete bearing the compression and the steel bars taking the tension strains. The corrugations of these bars prevent any slip or movement occurring between the concrete and the steel, thus insuring perfect union of the two. The steam roller shown in Plate XXXV, figure 2, weighs 10 tons. The opening shown is 5 feet square, having bars 6 inches apart, and the thickness of the concrete is also 6 inches. The culvert shown occurs on a curve where a stream crosses at a decided angle, so that the difference in cost between a long wooden bridge and this concrete structure was not very great. The cost of a 5-foot culvert of this type, under average conditions, including head and wing walls, is $9 per linear foot; without wing walls, $6.20.

COST OF MATERIAL AND CONSTRUCTION.

Madison County now has 29.15 miles of improved roads, of which 4.88 miles are the three levee roads built in 1894, or more than ten years ago; 24¼ miles represent the work which has been done since June 1, 1903, at a cost of $115,681.71, which includes every item of expense, as will be seen by reference to the following itemized statement:

Cost of road construction in Madison County since June 1, 1903.

Machinery and tools	$7,044.95
Blacksmithing and repairs	402.34
Rock (delivered on board cars at Madison County sidings)	48,885.64
Grading, hauling, and laying, complete	43,660.46
Permanent waterways	6,518.43
Right of way	1,177.71
Engineering, surveys, and superintendence	7,016.35
Office expenses	975.83
Total expenditure to date	115,681.71

COST OF STONE.

The average cost of the stone from the two sources is 99 cents per cubic yard free on board the cars at the quarries, and there is a shrinkage of approximately 10 per cent, due to settlement in transit, as shown by difference in measurements at the point of loading and on arrival at destination.

In calculating the quantity of material necessary to construct a road, it should be remembered that the difference between the measurement

of the material on cars or wagons at the quarry and after being thoroughly rolled in place on the road is close to 25 per cent.

It will be seen that the cost of the stone, on account of transportation from distant points, represents the largest item of expense in the construction of the roads.

The Madison County roads vary in width from 12 to 16 feet, the wider roads being near the city of Jackson.

COST OF GRADING PER CUBIC YARD.

Next to the cost of stone comes the cost of grading, which varies widely according to topography and reduction of grades. Profiles of two roads (figs. 35 and 36) will illustrate this clearly.

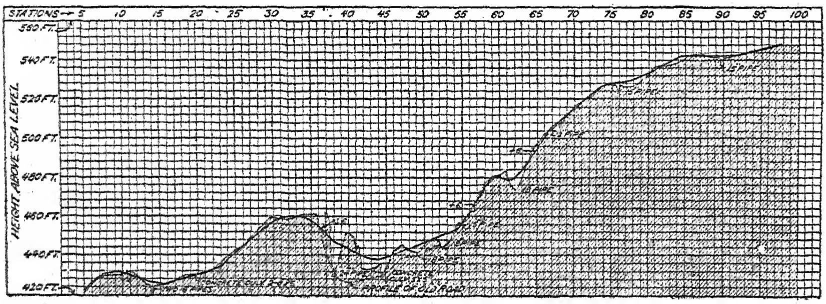


FIG. 35.—Profile of Christmasville road: Figures at left denote elevation; stations numbered at the top are 500 feet apart.

On account of the nature of Madison County soil, which washes badly, the condition of the old roads makes it necessary in many places to fill deep ditches and to widen cuts where the old roads are narrow and worn down by long use. In some cases it was necessary to incur

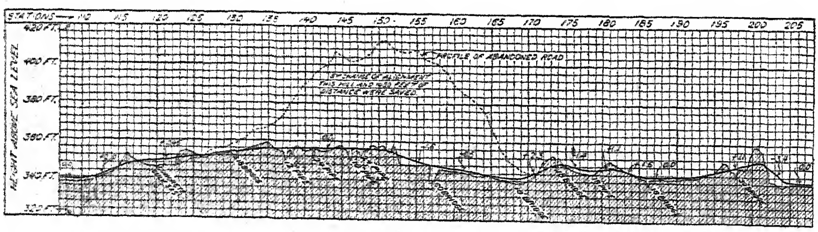


FIG. 36.—Profile of Lower Brownsville road: Figures at left denote elevation; stations numbered at the top are 500 feet apart.

the expense of picking down the side walls by hand before it was possible to use teams and scrapers to advantage. Those who are familiar with the cost of grading know that this is expensive. In other cases the grading is light, but the old surface, which is flat and irregular and often filled with brush which has served during the winter to keep the traveler from sinking out of sight, must be shaped and rounded to meet the new conditions. The old brush must be removed;

and, while the number of cubic yards of earth which must be handled is small, the cost per cubic yard is thus greatly increased.

The average cost of grading per cubic yard has been approximately 25 cents, some of it being done as low as 8 and 10 cents, while under other conditions it has cost as much as 40 cents.

COST OF GRADING PER MILE.

The average cost of the work, not including the price of the stone, but including the cost of grading, preparing foundation, rolling, unloading the stone, hauling it to the road, and laying it, complete, has been $1,800.43 per mile. The cost of unloading and hauling alone has been $584.56 per mile. As Jackson is near a river valley, most of the roads constructed thus far have climbed out of this valley and over divides. These roads have been made wider, and grades have been reduced from a maximum of 14 per cent, or a vertical rise of 14 feet in each 100, to a maximum not exceeding 6 per cent, or a vertical rise of 6 feet in each 100; and in many cases the reduction has been even greater than this. Farther out these steep grades are not so common, nor is it necessary in sparsely settled districts, where travel is light, to reduce them so greatly, nor will the roads have to be so wide; hence the cost of grading will be much less.

COST OF HAULING WITH TEAMS.

The cost of hauling the material to the road comes next in importance, and, where the distance is great, constitutes one of the largest items.

With the ordinary farm wagon provided with the slats and sideboards commonly used, and holding 1 cubic yard, it was found that the average team would travel, in a day of ten hours, an average distance of 24 miles, and it required continual urging to accomplish this. The price paid being $2.50 per day for wagon, team, and driver, and the haul being only one way, the cost per cubic yard per mile for hauling is, therefore, 20.83 cents.

During the fall months, the weather being cool, a different plan was tried, a 10-hour day being based on 28 miles of travel for each team at the above-named rate. Signboards, placed at regular intervals along the road, marked the time in hours and minutes allowed the owner of each team for material delivered between these points, a record being kept by the foreman in charge. Some drivers pushed their teams extremely hard, and forced them to travel as much as 40 miles, so that, at the close of the second day's work, the team was laid up on account of overwork; on the other hand, a few fell below the former earnings, but solely on account of inferior teams and incompetent drivers. The distance of 28 miles with favorable weather conditions was found to be all that a good team could cover in ten hours, and

be able to keep at it continually. The cost at this rate is, therefore, 17.86 cents per cubic yard per mile of actual haul.

COST OF HAULING WITH TRACTION ENGINES.

As the length of haul increases, the number of teams required to handle the material multiplies rapidly. Where the stone is shipped by rail a considerable distance, and is delivered in certain fixed quantities each day, teams must be found, or their substitutes. This regularity of shipment is necessary in order to provide steady employment for the men at the quarries, as also for the regular movement of cars.

It is a difficult matter to find always enough teams to meet the constantly increasing demand of long-distance hauls, and with teams the cost soon mounts up. The spilling of the new stone along the surface of the completed road, coupled with the continual grinding under narrow-tired wagon wheels, is calculated to break the surface and injure the roads. On this account it seemed desirable to undertake hauling by means of traction engines.

Through the editor of a well-known publication devoted to this interest the name of every builder of traction machinery in the United States was secured. Bids were obtained on two traction engines and ten steel cars especially designed for this particular purpose. A contract was awarded under the guaranty that the outfit would prove a practical success for use in hauling stone to be used in the construction of a system of country roads and be able to show a saving of 25 per cent over team hauling, the tests to extend over a certain period of time. The engines were to be capable of drawing 30 tons up a 6 per cent grade at the rate of 2 miles per hour, weight of engine not to exceed 11 tons, and to carry coal and 300 gallons of water. While returning with the empty cars the engine was to develop a speed of 6 miles per hour by shifting into a high-speed gear. Plate XXXVI, figure 1, shows one of these engines taking water 3½ miles from the starting point and drawing four cars of stone each containing 5 cubic yards.

The cars or wagons dump and spread the material automatically, and can be run in either direction without the necessity of turning around, it being only necessary to turn the engine, which can be accomplished easily in a very short space. The wagons follow one another, and in turning short angles track perfectly. The wheels are broad and serve as rollers to compact the roads more thoroughly. On a haul of $3\frac{7}{10}$ miles they were able to travel 35 miles in a day and to draw each time 20 cubic yards. On account of winter weather, construction work on the roads was suspended and the tests have not been completed.

While traction engines have been used extensively throughout Europe and played an important part in the Boer war, they have not

FIG. 1.—THE EVOLUTION OF A COUNTRY ROAD—5. DECEMBER 5, 1904.
[Team drawing 12 bales of cotton over finished road where only 2 were drawn before.]

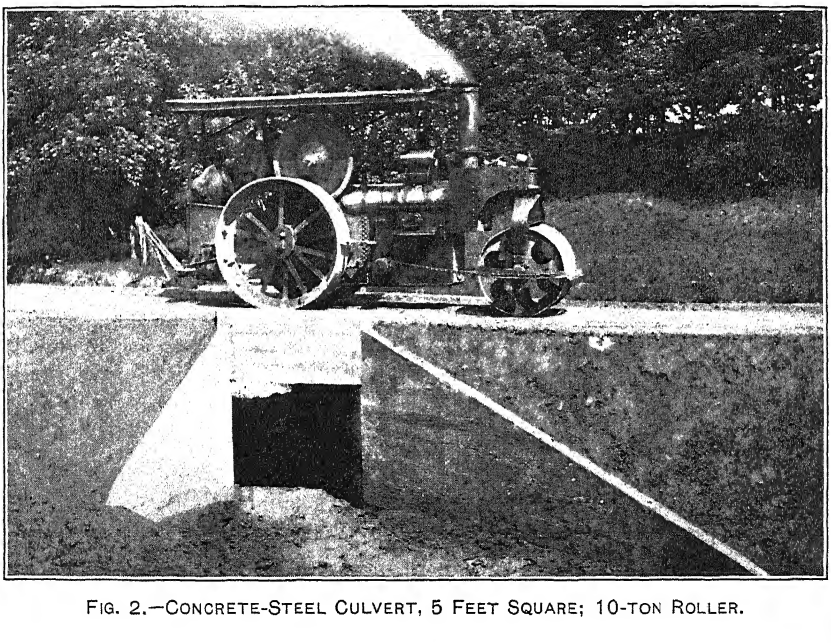


FIG. 2.—CONCRETE-STEEL CULVERT, 5 FEET SQUARE; 10-TON ROLLER.

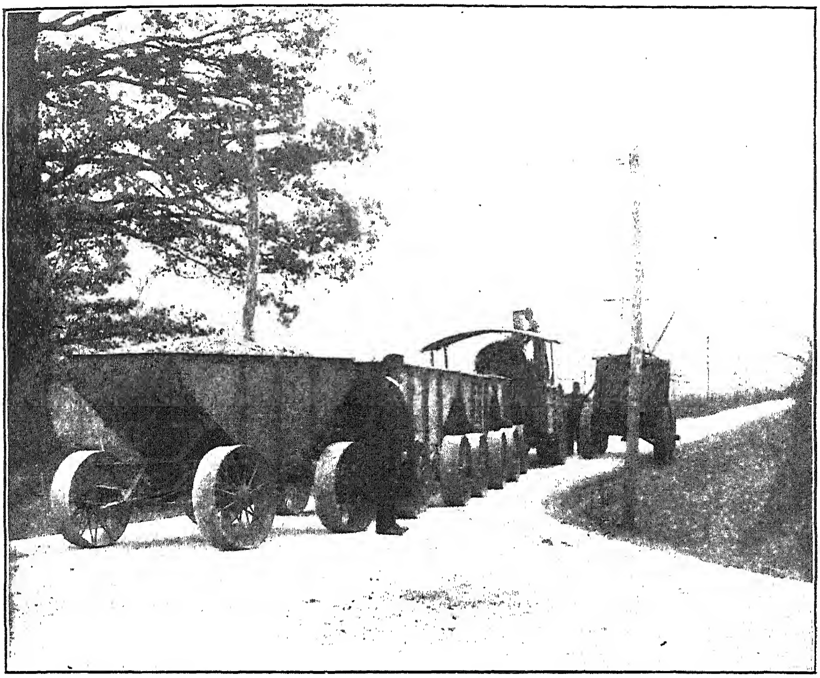


FIG. 1.—HAULING ROAD MATERIAL WITH TRACTION ENGINE.

[Four cars, each holding 5 cubic yards; engine taking water.]

FIG. 2.—CAMPBELLS LEVEE ROAD IN JANUARY, 1905.

[Road was improved in 1894; repairs have cost only $33 per mile per annum since.]

been extensively used in this country for hauling on public roads, and a great deal must be learned by experience. The writer feels safe in predicting that, with the growth of the movement for better roads, and the increased haul as these roads are built away from the source of supply, hauling with traction engines will come into general use and will reduce the cost of delivering the stone on the roads to less than 10 cents per cubic yard per mile after taking into account all proper charges, such as operating expenses, fuel, oil, depreciation, interest, etc.

COST OF ENGINEERING, SURVEYS, SUPERINTENDENCE, AND OFFICE SERVICE.

These important parts of the work have been executed with the smallest possible force. Each man has been deeply interested in his particular line, and his work has been well and thoroughly done. Each was impressed with the fact that the future of improved roads, in this section at least, depended on the practical success of our roads.

The cost of engineering, superintendence, and surveys will compare favorably with similar work done in any other State, it being $7,016.35, or only about 6 per cent of the total amount expended. The office expense is also small, when it is considered that the engineer issues all vouchers after having carefully checked every bill, makes all pay rolls, and pays each individual laborer by check.

SAND FOUNDATIONS.

The general character of the Madison County soil varies from alluvial to sticky red clay, and there are some strata of sand. There are numerous instances where the roads traverse valleys and sand has washed in, making the roads heavy and extremely difficult to travel. In the outset of our work the question most often asked was, What are you going to do when you come to the sandy places?

As a matter of fact, nothing makes a better foundation for a stone road, provided, of course, that it is properly ditched, so that when rain and floods come the sand is not washed from under—for, after all, sand is made up of minute particles of stone.

We have built some heavy embankments entirely with sand taken from the bed of a neighboring stream, it being the most available material, and after completion only a few inches of soil has been spread over the whole before adding the stone. The sides of the embankments are then planted with a jointed grass known in this section as "Bermuda," which grows rapidly, spreading by means of underground rootstocks, holding the soil and preventing it from washing. In the Northern States, where this grass does not grow, wild honeysuckle is a good substitute. The Pennsylvania Railroad uses it extensively to prevent its roadbed from washing. No finer roads are to be found than those which we have built on sand, since

it provides an excellent underdrain, which adds greatly to the life of the road.

Nine out of every ten men who passed over these sand roads during construction had something to say about the foolishness of using sand for this purpose, all predicting failure. When the same citizens now travel these roads, their teams pull with ease many times the former loads and cover the distance in less than half the time.

MAINTENANCE OF THE ROADS.

As previously shown, the cost of maintenance on the levee roads first built has been small. The labor has been performed by the workhouse force. The first roads built by the good roads commission in June, 1903, are now in excellent repair, and no work whatever has been done on them. They will naturally require some repairs, which should be made systematically. In the care of roads, as in everything else, the proverbial "stitch in time" prevents great waste. The legislature of 1905 has been asked to enact a law abolishing the ineffective system in vogue of "working out" the road tax and, instead, require a reasonable cash tax, the maintenance and care of the roads to be in the hands of the good roads commission.

Cast-iron mileboards, having raised letters, and mounted on iron T-posts, have been planted in concrete and serve as permanent markers. A quantity of suitable stone for repairing the road is piled around them. Still other piles of such material are placed at the end of each quarter mile, and thus the material is always at hand when needed. Repairs can be made in the spring season, when the frost comes out and the rains have washed the surface clean. The new material then added to fill the holes will more readily bond—for it should be remembered that, if new material is thrown into a dirty dry rut or hole in the road it will not adhere, or it is easily loosened again by heavy travel, as the loose dirt prevents the new material from uniting with the old.

It is the purpose of the commission to place one man with a mule and cart in charge of certain sections of road, he being responsible to the commission for its condition. A daily report to be filed in the office of the chief engineer on printed blanks will indicate the exact work done by this man each day.

Prompt attention insures a small expense for repairs, and the cost will be less to the taxpayer than under the present antiquated system, where the road is seldom repaired until it can no longer with safety be traveled.

The cost of repairs on the first of the levee roads improved in 1894 has been less than $33 per mile per annum, while the cost of repairs and maintenance of the old plank road amounted to $684 per mile per

annum. Plate XXXVI, figure 2, shows one of these levee roads as it appeared January 18, 1905, and illustrates their condition.

RESULTS OF GOOD ROADS IN MADISON COUNTY.

It has often been said that "good roads mark the line between barbarism and civilization in any country." A few of our people, appreciating this fact, began many years ago planning to better the condition of the roads and to meet successfully the resistance offered by objectors. Possibly the best has not always been made of the advantages offered, but the fight is being won; and the problem is being solved, locally at least, with a fair degree of success. The ability of a community to improve at least a portion of its more important roads has been demonstrated. A well-built piece of road in every community is the best possible advocate for an extension of the system.

We have in this county approximately 200 miles of important roads, roads possessing more than a neighborhood value, which ought to be improved; we have started at the center, the hub of the wheel, and will push the roads out as far as possible. With lighter grades, and profiting by the experience gained, we expect to have 80 miles of well-improved roads, or, better still, if the prison force is turned to good account, we may hope to have even 90 miles of these good roads when the authorized $300,000 has been expended.

LAND VALUES INCREASED.

Since the construction of these roads began in June, 1903, the land values throughout the county have increased, in many instances from 20 to 100 per cent, and the city property has greatly advanced in value. There are no houses "to rent" in Jackson; builders are busy, numbers of new real-estate offices have been opened, large tracts of farm land are being subdivided, and prices are being paid which astonish the most far-seeing champion of this now popular movement.

New families from adjoining counties and States are constantly coming in, some to make their homes in the city and others wanting farms on the "good roads." Still others, looking ahead and anticipating profits, have made purchases 5 and 6 miles back from these roads, paying largely increased prices.

To illustrate this, as well as to show a typical change made in the location of a road, a map (fig. 37) and a profile (fig. 36) are given showing the old road, which climbed to the top of a hill 71 feet in height, turned a right angle, and descended again to a point lower than the starting place. A hard fight was required to secure a change, and right of way had to be bought, but the road, built as indicated across the hypothenuse of the triangle, avoided the hill and made a magnificent road,

with no more grade than is necessary for proper drainage, so that a team now pulls all that the wagon will sustain.

The farm on the top of the hill had been owned for several years by a bank, it having been taken to satisfy a debt, and had fallen into neglect, being badly washed. The tenant, an indifferent one, who lived in the single poor cabin on the 152-acre tract, paid $100 per year rent.

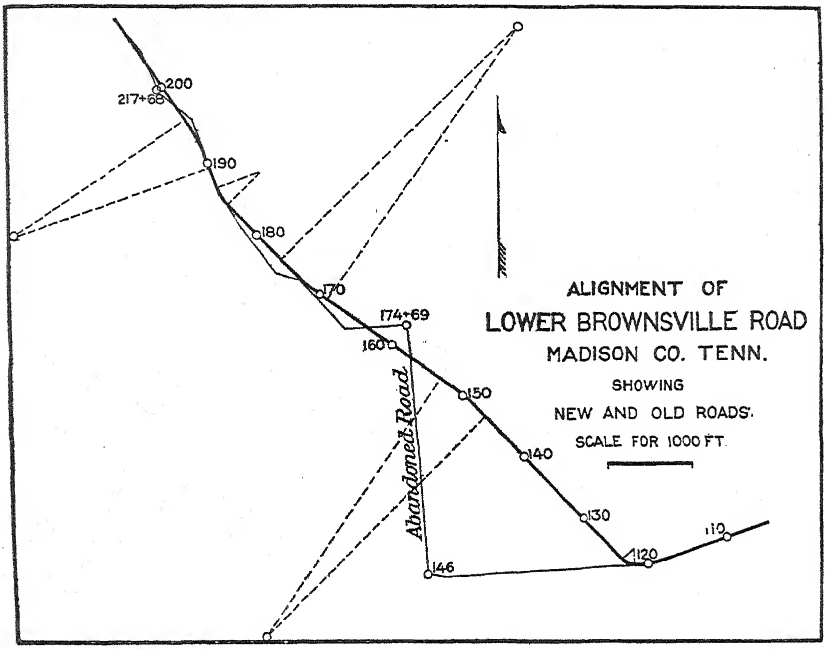


FIG. 37.—Alignment of Lower Brownsville Road; also the line of the old road. For profile, see figure 36.

A progressive real-estate dealer purchased the tract at a price considerably above that which the bank had asked only one year before, divided it into three tracts, and sold it again to three representative farmers. Good homes are now being made for the reception of families on each of these three tracts, fruit trees are planted, and thrift and industry prevail where indolence and improvidence existed but a short time before.

SUGAR-BEET SEED BREEDING.

By J. E. W. Tracy,
Seed Expert, Bureau of Plant Industry.

INTRODUCTION.

Although the manufacture of sugar from beets in the United States dates back three-quarters of a century, the enterprise has not been successful from a commercial standpoint until within the last fifteen years. Before 1890 only a few factories had been established in the United States, but since that date many have been built, until to-day we have fifty-four completed factories, besides several in process of construction. They have cost approximately $40,000,000, and have a daily capacity to manufacture approximately 4,800 tons of refined sugar from 42,300 tons of roots. The area required to produce these roots would be over 400,000 acres. The gross return to the farmer from the area cultivated last year was nearly $42 per acre.

EFFECT OF INCREASE IN SUGAR CONTENT OF BEETS.

The reported extraction for all beets worked in the United States in 1904 was 11½ per cent, or 230 pounds of commercial sugar manufactured from each ton of roots. In Germany, where the raising of sugar-beet seed and the manufacture of sugar have probably reached their highest development, the percentage of extraction is considered to be so largely dependent upon the quality of the seed used that the most carefully managed factories insist upon having all the seed used by them grown under their own supervision and on such soils and under such climatic conditions as experience has shown to be best adapted to their particular localities. Here in America comparatively little attention is paid to this matter, and consequently certain factories have been financial failures, largely because of negligence as to the actual character of the seed they distributed to their growers. It is conservative to say that the average percentage of extraction in this country could be increased at least 2 per cent by the use of as high a grade of seed as is used in Europe. This increase of 2 per cent in the available sugar in the beet would make a difference of 40 pounds of refined sugar to each ton of roots worked, which, to a factory working 50,000 tons of beets a year, would mean an increase of 2,000,000 pounds of sugar. At this rate the total product of all the factories in the United States in 1903 would

have been increased by more than 40,000 tons. Such an increase would mean the difference between profit and loss to many factories, with no increase of capital tied up in their plants and with but a slight increase in the actual cost of production. Where a "flat rate," that is, a uniform rate paid for all roots regardless of their sugar content, is in vogue, there would be no additional expense for the roots; but where a "sliding scale" is used, the price paid depending upon the sugar content, an increase of 50 cents per ton for roots would be incurred. The cost of hauling and slicing the roots and the extraction of the sugar would not be increased, while the chief additional expense would be in the purifying and handling of the finished product, both of which are comparatively inexpensive items in sugar manufacture.

It can readily be seen that our factory men must be more careful to secure seed of the best quality, as it is essential to the profitable working of their factories. It seems positively astonishing, to one who has observed with what care and thought the factory men in Europe attend to the selection, breeding, and culture of their seed, that sugar men in America give so little attention to the seed they plant. Sometimes a brand of seed is bought because a favorite clerk acts as the paid agent of its producers or of those who furnish it; sometimes because the grower and the factory manager were school friends; many times solely because it is cheapest—cheaper by a few cents a pound, but dearer by many thousand dollars in the value of the sugar output. The difference in the cost of the best and the cheapest grades of seed is rarely more than 4 cents a pound, so that, allowing 18 pounds to an acre for planting, the additional expense would amount to but 72 cents per acre. The average yield of roots for the entire United States last year was 8.4 tons to the acre, which, with an increase of 2 per cent in the available sugar, would give an increase of 336 pounds of sugar per acre at an additional cost of but 72 cents per acre for the seed. The total extra expense for seed for a 500-ton factory would be $3,600, while the sugar output would be increased 2,000,000 pounds, valued at some $90,000.

DISADVANTAGE OF RELYING UPON FOREIGN-GROWN SEED.

While there are careful and painstaking growers in France and Germany, where the great bulk of the sugar-beet seed used in this country is produced, there are many who are not only careless in their methods but dishonest in their practice in handling sugar-beet seed. They pose as growers and claim to make extensive analyses every year of individual roots, whereas in reality they simply buy seed where they can do so most advantageously, regardless of its quality. A large proportion of the seed used in the United States is furnished by such dealers, while the better class of German growers who, through fifteen

or twenty generations of plants, have conducted most careful field and experimental trials and annually spend thousands of dollars in testing individual roots and making records and photographs of them, sell but very little seed here. This is largely due to the lack of interest and failure on the part of the American seed-buyers in investigating the methods and establishments of those from whom they secure seed.

The information one generally secures from sugar-beet seed growers, not only as to their own business, but as to that of their associates as well, is frequently unreliable. Exaggeration is very common, and it is frequently impossible for an outsider to reconcile the results of his own observations with the statements made, both in conversation and in print. Seed which is sold as having been grown in the most careful and scientific manner is often actually the cheapest and poorest grade of seed procurable. It consists of both new and old seed, which has been grown under widely different conditions of soil and climate, and is mixed together by specially constructed machinery. It is explained that the different lots of seed are mixed to insure an evenness both in the germination of the seed and in the quality of the crop. The absurdity of mixing all kinds and grades of seed to produce uniformity in the crop is evident.

It is generally admitted that the sugar beet, being one of our most highly bred plants, is very susceptible to the influences of both climatic and soil conditions; hence seed should be used which was produced under the most favorable conditions for the production of beets best suited to each particular locality. The best seed imported is raised for the most part under very similar climatic and other conditions, but it is sown here in America under all conditions and in all soils, in New York and Michigan, Nebraska and Washington, and in the arid and semiarid regions of Utah and California. No single strain can be the best for all of these varied localities. We can never expect to secure the best results in our sugar-beet industry when we have such conditions in the seed branch of the business.

IMPORTANCE OF GROWING SUGAR-BEET SEED AT HOME.

It is absolutely essential to success that we secure the best quality of seed, and past experience has conclusively shown that we can not depend upon doing so from abroad. We must raise it ourselves, and in such a careful, scientific manner that it will not only be of the best quality, but will have such characteristics as will make it adapted to the particular needs and requirements of the locality where it is to be sown. Seed raised on a particular soil and under certain climatic conditions may not be best suited for planting in like soils and under similar climatic conditions; in fact, very often it is not. Seed from comparatively poor soil may do best on rich soil, or that raised in the

East may do best when sown in the West. Only study and personal experience on the part of each factory manager can determine what seed is best suited for the conditions in his region.

For several years efforts have been made to raise seed on a commercial scale in various sections of the United States, particularly in the States of Michigan, Nebraska, Utah, Colorado, and Washington, but not until recently has any serious attempt been made to raise it from pedigreed roots, or in accordance with the scientific methods found to give the best results.

EXCELLENCE OF AMERICAN-GROWN SEED.

During the last three years the Department of Agriculture has been conducting extensive experiments in testing American-grown seed in comparison with the best grade of imported seed procurable. These experiments have shown a marked difference in sugar content, purity, and yield, and in these qualities the American-grown seed compared most favorably with the imported. This is remarkable, as the American-grown seed was grown by seedsmen who had little knowledge and made little use of the scientific methods practiced in Germany. If it is said that the superiority of American-grown seed in these trials was due to the fact that the imported European seed was of inferior grades, then it is high time we gave up depending upon Europe for our supply, as every effort was made to secure for these comparative tests the best grades of seed procurable in Europe, and the prices paid were as high as those paid by the most critical factories there. If it be said that the soil and natural conditions were responsible for the superiority of the American-grown seed, it makes more evident the desirability of growing our own seed and emphasizes the importance of our doing it according to strictly scientific methods.

OUTLINE OF METHODS FOR PRODUCING SUGAR-BEET SEED.

It is well to consider carefully the methods in breeding sugar-beet seed which are followed by the best European growers, and which are the result of long experience and most careful scientific investigation.

There are three methods of producing sugar-beet seed:

(1) Raising seed directly from roots selected according to physical characters, without analyzing them chemically.

(2) Raising seed directly from individually selected and analyzed roots and testing the product of each root separately.

(3) Raising seed indirectly from individually selected and analyzed roots.

The first method is by far the cheapest and quickest, and as such is largely practiced, but by it we can not secure seed of the highest quality. It consists in eliminating all prongy and ill-shaped roots, those sending

up seed stalks the first year, and all sickly and abnormal roots. Practically all the remaining roots, regardless of their sugar content and purity, are planted for the production of seed, which in turn is sown and produces small roots, the product of which is placed on the market as commercial seed Unfortunately, much of the seed which comes to America is grown by this method, and the best results can never be obtained where it is used.

The second and most scientific method consists in line breeding from roots excellent in form, texture, weight, sugar content, and purity, and which have been proved to possess the power to transmit their good qualities. The seed of each root is harvested separately, actually tested in field trials, and if its product is found not up to the standard of excellence required it is discarded, no matter how superior the root itself may have been. About one-half of 1 per cent of the roots tested are found suitable for breeding stock or for "breeders," and these exceptional specimens are used as foundation stock for new families. This method of producing seed directly from analyzed roots has decided disadvantages, as it is impracticable to produce large quantities of seed in this way, though it is by far the best-known method for the production of stock seed from which roots for use in the third method may be grown. Its great advantage lies in the fact that it makes possible the breeding from individual roots which have been most carefully tested and recorded and whose progeny are so isolated that it is possible to determine by actual test how closely they approach the mother plant, what qualities are hereditary in each mother root, and what influences are acting upon the plant.

As the third method is the best and most practicable one used in the production of commercial seed, it will be described more in detail, as it is practiced by some of the most thorough, careful, and painstaking growers of Europe.

THE BEST METHOD OF PRODUCING COMMERCIAL SEED IN QUANTITY.

The securing of good breeding roots is not only the most difficult and most expensive work connected with the culture of sugar-beet seed, but requires more earnest effort, together with more scientific and agricultural knowledge, than any other branch of seed raising. The character of the results is largely dependent upon the ability of the grower not only to grasp and understand the general principles of plant breeding, but also to recognize atavistic tendencies and other qualities of the individual plants. Success also depends largely upon a proper understanding of the laws governing the correlation of qualities, and a misunderstanding or neglect of these laws may be the cause of failure to produce seed of the highest quality, even when the greatest care and skill in other respects have been exercised.

In the proper selection of roots, many qualities and characteristics must be taken into consideration and their relative importance thoroughly understood. Among these are the following: (1) The form and shape of the root and the influence that its surrounding conditions have had upon it while growing; (2) the color and texture of both skin and flesh; (3) the color, shape, texture, and habit of the leaves; (4) the number of individual leaves and leaf circles; (5) the tendency to produce seed stalks the first year and the influence that climatic and other conditions have had in developing this tendency; (6) the health and vigor of the roots, and what influence, if any, inbreeding and climatic conditions have had upon them. It is in regard to such matters as these that we must inform ourselves if we would raise as good sugar-beet seed as the most careful growers of Europe. There are practically no secrets regarding the planting of the seed, caring for the crop, curing, siloing, and analyzing the roots, and harvesting and curing the seed, which can not be learned by a careful observer, but there is much to be learned regarding the influence of correlated qualities, heredity, soil, and climate. (Pl. XXXVII.)

While the weight, high sugar content, and high purity are of course the points to be considered in breeding sugar beets, still they in themselves do not include all the qualities to be considered in selecting roots for breeding purposes, but are in fact the ends to be attained and not the means by which we attain them. One must never lose sight of the qualities sought and obtained, and an exact type must be adhered to in the selection, which can only be done when the type is clearly defined and described. The qualities desired should be definitely, clearly, and fully stated, and the statement supplemented with photographs or drawings, so that it is possible at all times not only to accurately describe the ideal sought, but to determine how closely the ideal has been approached. The qualities of the root were inherent in the seed from which the roots were grown, and their development is the result of the characters of the mother roots, including their prepotency or ability to produce seed which will develop into plants like themselves. This prepotency is largely the result of hereditary influences which can be surmised with a good deal of certainty from the record and photographs of its ancestors. Even though one may select roots of good weight and high sugar content and purity, if, through want of prepotency or other causes, these roots lack the power to transmit those good qualities to their progeny, they are practically worthless as mother beets. While occasionally individual roots may show remarkable powers as transmitters, yet, in the great majority of cases, it is only by breeding for the same qualities for a number of years that we may hope to secure constant results in the progeny. If for thirty or forty years all roots not conforming to a most strictly

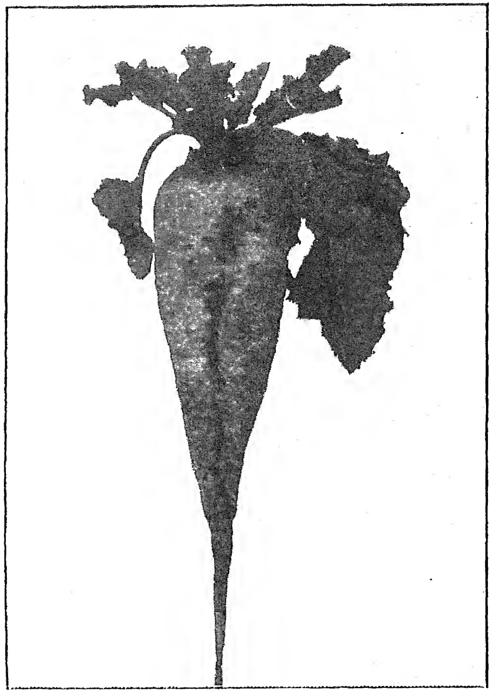


FIG. 1.—ONE OF 15 ROOTS IN SILO AT FAIRFIELD, WASH., PRODUCED FROM WASHINGTON-GROWN SEED WHICH TESTED 24 PER CENT SUGAR.

[An acre of such roots, calculated from the average tonnage of the entire area planted in the United States last year, would produce 42,000 pounds of refined sugar, or 100 pounds of sugar to every 4 square rods.]

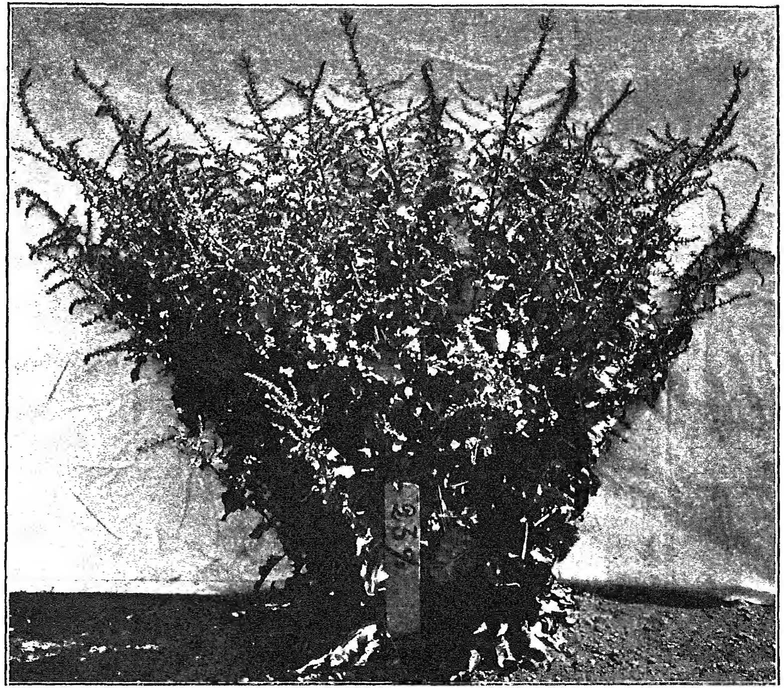


FIG. 2.—"MOTHER" ROOT IN SEED, WHICH TESTED 23 PER CENT SUGAR IN THE BEET.

[A strain of such seed would increase the yearly production of refined sugar of the present factories in the United States by more than 300,000,000 pounds.]

defined type are discarded, as has been done in some places in Germany, it is reasonable to assume that the progeny of the roots retained will more nearly conform to that type than that of roots whose immediate parents were of the desired type, while their ancestors were of varied form and character. While individual variations occurring in a stock are to be avoided, and in fact when too many varying roots occur, the entire line must be discarded, still such variations may be used as foundation stocks for new families. The progeny of these varying roots, however, must not be considered either as of particular merit or as constituting a new family until, after several generations, they have shown their characters to be constant or fixed. While improvements, as with all sorts and varieties of vegetables, must be from individual plants, in practice the plants are not isolated and bred separately, but rather by families. Individual roots are analyzed, recorded, and photographed, and pedigrees of line breedings are made; these records are not, as relating to the progeny, wholly correct, for a number of roots closely approaching each other in shape, actual weight, leaves, habit, sugar content, and purity are grouped together and planted in one plot to constitute a family and become of necessity more or less cross-fertilized with one another. Even though these records do not include that of the influence of cross-fertilization, they are very essential as records of the family as a unit, and upon them is based the entire system of the introduction of new blood and the breeding for definite qualities. The seed of each of the 50 or more roots which have been grouped into a family is separately harvested and tested by planting separately in the field, and any which show inferiority are rejected.

EFFECTS OF SOIL AND ENVIRONMENT.

While many seed growers and sugar men here in America do not generally concede that the soil, the nature and quality of fertilizer used, and the climatic conditions have a marked influence on the permanent qualities imparted to seed, it is generally so believed among European growers, and these factors are considered of such essential importance by them that, generally speaking, they insist upon having seed grown in certain localities and upon particular soils, which either conform most nearly to those in their several localities or which experience has shown them give the most satisfactory results. Such growers consider it positively necessary to resort to an invigorating, regenerating power where seed is grown continually in one section. This may be done by the introduction of new blood into a family, or, if preferred, stock from the same family that has been grown under different circumstances and conditions. The practice of persistently growing an entire family on one farm under uniform conditions is recognized as a

mistake by European growers, who consider it absolutely necessary to have plantings of their seed in widely different sections and under different conditions. It is not meant by this that one lot of seed will show distinct signs of difference in a year or two; it may be but very slight or even indiscernible after a number of years; but it is considered a positive fact that, if seed is grown under exactly the same conditions and in the same kind of soil year after year, it will certainly show distinct signs of deterioration or "running out." Even when a soil and locality are found excellently adapted to the raising of good seed it is vital to the continuance of the high quality of the seed either that it be regenerated by the use of new seed or that the same effect be produced by a change of soil and climatic conditions. These different conditions may be found in comparatively close proximity, possibly within a mile or two. By the introduction of new seed is not meant seed of distinctly or even widely different type, but rather seed produced under somewhat different circumstances and containing some foreign blood. The proportion of this may be very small, as, in line breeding of animals, new blood having three-fourths, seven-eighths, or even fifteen-sixteenths of the original line answers the purpose.

TESTING THE CHARACTER OF THE SEED.

No matter how skillfully the work of selecting and breeding has been done, its results can be positively determined only by the most careful tests of the character and value for sugar making of the seed produced; and in this the German growers exercise a marvelous amount of care and skill. First, great care is taken to secure fields as uniform as possible in soil and other conditions, and no fields are used which have not been manured and cropped in the same manner for a number of years. It is, however, generally impossible to secure fields all parts of which are absolutely uniform in character; therefore, soil maps, including both physical and chemical analyses, are made which show the exact condition of all parts of the field. Where there is the slightest difference as to soil, drainage, or physical properties, the rows are made to run so that no sample will occupy unfavorable ground. Oblong, triangular, and irregularly shaped spaces of undesirable soil are discarded, and the rows are made to run around them, so that the field has the appearance of having been planted in a most haphazard manner. As experience has shown that the yield of isolated roots is greatly increased by the fact of their being so isolated, the individual seed balls are planted one foot apart each way and covered by hand to the uniform depth of three-fifths of an inch. Should any ball not germinate, then two or three rutabaga roots are planted in its place. At harvest time, if it is found that any vacant places still occur, the roots surrounding these spaces are weighed and 50 per cent of their

weight is deducted, as careful records covering many years have shown that such roots increase to that extent by being so isolated. These tests should be, and with the best growers generally are, made in duplicate, so that each sample is tested in at least two fields in the same locality; and, where possible, a second complete series of tests is made in different sections and upon areas having different climatic conditions, the size of the plots in each case depending upon the relative importance of the sample or the amount of seed available. Careful and complete notes are kept regarding the growth and general characteristics, and the effect of climatic and soil conditions from the time of planting the seed, of every sample tested, so that comparisons may be made of the behavior of each in the various soils and sections where they are sown. Should the roots grown from any sample, on being tested in the laboratory, prove to be not as uniformly high in sugar content and purity as the original beets from which they were raised, the entire product of both roots and seed is discarded. The remaining samples of seed of the group are then put together and treated as one family.

In the laboratory two different sets of tests are made. The first is a composite test to determine the value of any one sample as a whole, the second is an individual test to determine the value of each root. The first test is made of 25 or 50 roots, and is used to eliminate all poor samples or such as have deteriorated from their mother roots. This is a comparatively rapid and inexpensive process, for but one test is required of each sample. The second is expensive and requires much time and a well-equipped laboratory. (Pl. XXXVIII.) It is used for the selection of the best roots from such samples as show well in the composite test for use as breeders in carrying on line breeding. In making this test a core one-half to three-fourths of an inch in diameter is removed by a boring machine and tested for sugar content and purity. This final test is the severest and most complete that can be made, for it not only includes the actual performance of the seed, but its constancy as related to the qualities of its ancestors. Less than one-half of 1 per cent of the roots tested in this manner are found suitable for breeding work. These "mothers," as they are called, are planted, and the seed grown from them is termed "elite" seed. While it is difficult to determine the actual cost of this seed, most growers estimate it at from $5 to $10 a pound. Still, there are growers who advertise to sell true "elite" seed for a slight advance over the price of ordinary seed. The fact is that it is quite impracticable to furnish this seed for factory purposes, and claims that it is placed on the market are not only absurd but proof of intention to deceive. The true "elite" seed is used only for the production of small roots termed "stecklinger," which in turn are planted and produce commercial seed.

SUMMARY OF STEPS IN SCIENTIFIC GROWING OF SUGAR-BEET SEED.

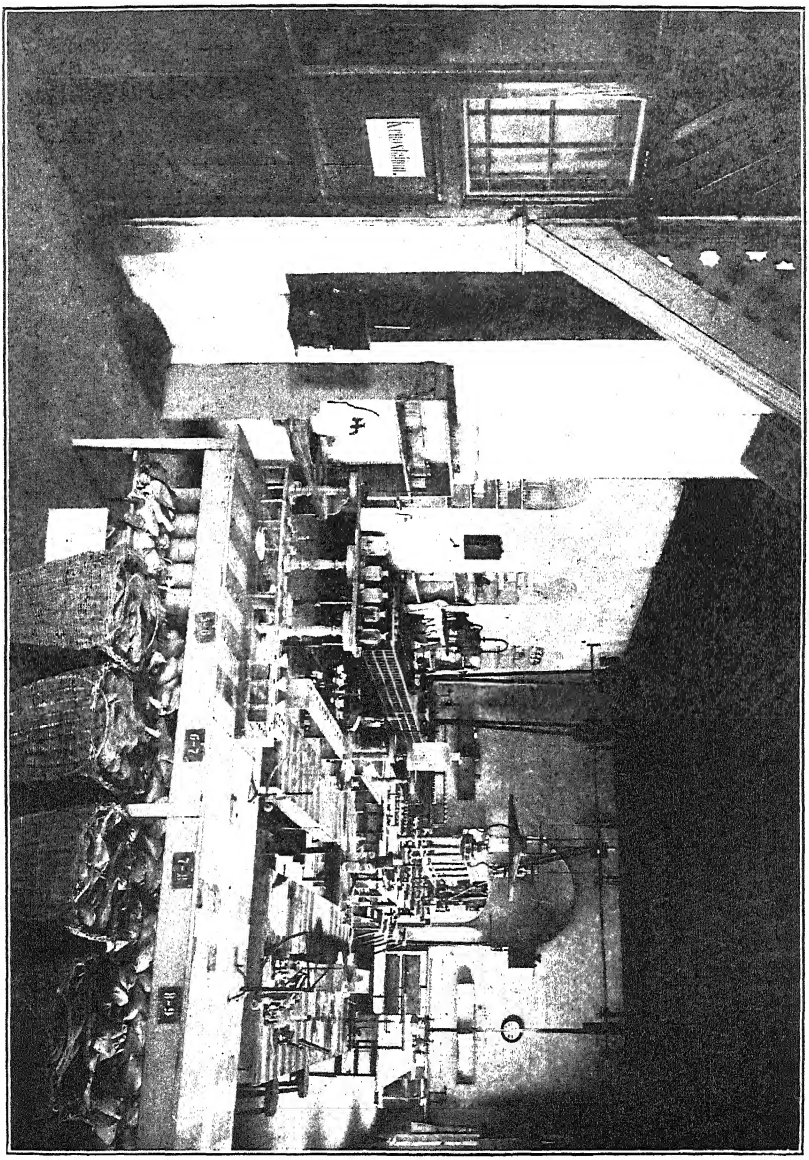
The breeding and establishing of pedigreed sugar-beet seed families is a much more complicated process than with most other plants. Take, for example, the raising or establishing of a new family or strain of carrots or turnips, both of which are biennials similar in character to sugar beets. The best strain of seed procurable, planted in the late summer, will produce roots by late fall, when such as may be desired can be selected, planted in hot-beds, and, being transplanted under glass, will produce seed by spring. This seed can be immediately sown, and from the resulting roots seed can be produced on a commercial scale before the following winter. Thus, in a year and a half, it is possible to produce seed on a commercial scale from a very limited number of plants.

With sugar-beet seed it is a much longer process. If, for example, the best strain of sugar-beet seed procurable is sown in the spring of 1904, it will produce roots by the fall of 1904, from which the best 10 roots may be selected according to their physical properties and chemical analysis. These may be planted in the spring of 1905 and will produce on an average 1 pound of seed from each root in the fall of 1905. The larger portion, say 9 pounds, of this seed is sown to produce roots for seed production, the remaining 1 pound being used for growing large roots to be used in testing the prepotent qualities of the seed. These tests will probably show that not more than 5 of the separate lots of seed are satisfactory for breeding purposes, and the roots from the unsatisfactory lots will be discarded. This leaves but the roots grown from 5 pounds of seed for breeding purposes, which would probably be sufficient for planting not more than 2 acres for seed purposes in the spring of 1906. The yield from these 2 acres will produce from 2,000 to 2,500 pounds of seed in the fall of 1906. This seed is sown in the spring of 1907 to produce "stecklinger," which, when planted in the spring of 1908, will produce seed on a commercial scale in the fall of 1908. Thus, five years will have elapsed before the seed can be raised from selected roots on a commercial scale.

GROWING AND SILOING OF SEED ROOTS.

The care and production of the roots from which "mothers" are selected is the same as the care and production of roots grown for factory purposes, which have been fully discussed in the various reports of the Department on the "Progress of the beet-sugar industry in the United States." The production of "stecklinger," or the small roots used for the production of seed, differs from this only in the quantity and quality of fertilizers used, in the planting of the seed, and in the thinning of young plants.

PLATE XXXVIII.



A WELL-EQUIPPED GERMAN SUGAR-BEET TESTING LABORATORY.

[A similar laboratory is being established by the Department of Agriculture at Fairfield, Wash.]

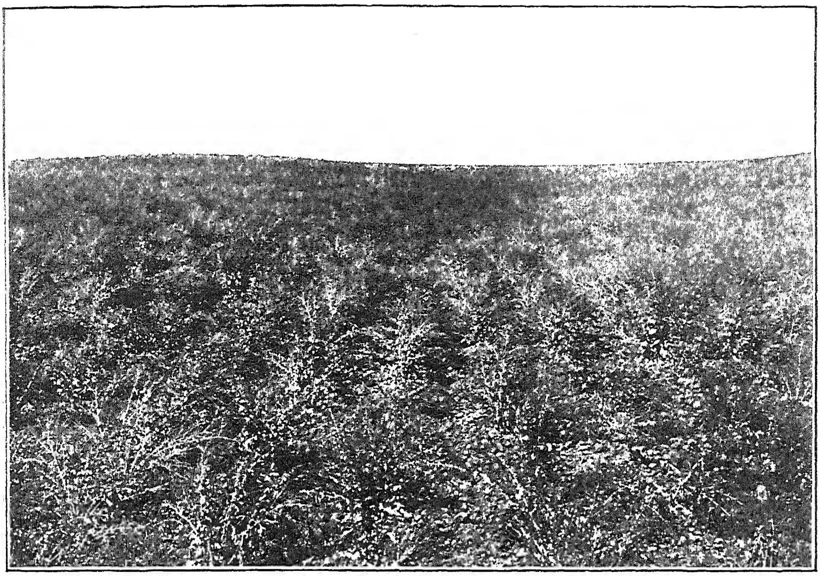


FIG. 1.—FIELD IN BLOSSOM.

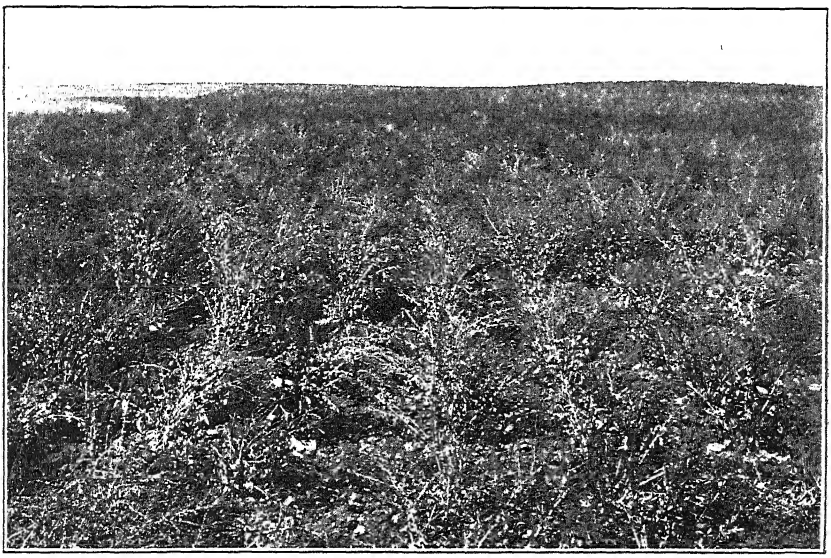


FIG. 2.—FIELD READY FOR HARVEST.

VIEWS OF A PORTION OF A 40-ACRE FIELD OF SUGAR-BEETS GROWN FOR SEED AT FAIRFIELD, WASH., IN 1904.

[This is one of the few large fields grown in the United States.]

The seed for the production of "stecklinger" should be thickly sown in broad rows 12 to 18 inches apart, 20 to 25 pounds per acre being used. Great advantage is secured by sowing the seed in broad rows rather than in narrow drills, as is customary when growing roots for factory purposes, for thereby two or three roots may be grown side by side and the number of roots secured to the acre greatly increased. While this crowds the roots, it is considered advantageous, as the crowding dwarfs the roots somewhat and hastens the time of ripening, thus giving them a longer time in which to harden off thoroughly before frost, and as a result they keep very much better through the winter. The young plants should be thinned to about 1 inch apart in the rows. The roots vary in size from one-half inch to 1½ inches in diameter and weigh from 2 to 10 ounces. An acre sown to "stecklinger" will produce a sufficient number of roots for planting 10 acres, which in turn produce from 14,000 to 20,000 pounds of seed. Before pulling, all roots showing any tendency to send up seed stalks, as well as those whose leaves do not conform to the type of the family, should be removed and destroyed, and, after pulling, all such roots as show any tendency to divert in any way from the original type selected should be likewise rejected.

The greatest care must be taken in pulling and sorting the roots preparatory to siloing them for the winter, to see that none are bruised or injured, as such roots rapidly decay and are likely to so spread the infection that the entire silo may be destroyed before spring. There are a number of different kinds of silos, which, however, differ in detail of construction rather than in principle. A popular one is made by digging pits 15 inches deep, 3 feet wide, and about 9 feet long. The "stecklinger," with all the leaves on, are placed in these pits in long, hollow, tapering piles or "ricks" running the entire length of the silo. The interior open space is about 12 inches wide at the bottom and is formed by piling the roots with the tops of the roots about 1 foot apart on the floor of the pit and gradually drawing them together as other roots are placed in position, so that in the completed silo an air chamber runs the entire length of the rick. While silos of any length may be constructed, they are seldom made longer than 9 or 10 feet, for in case decay should start in any one portion, it might destroy the entire contents of the silo before spring. (Pl. XXXIX.)

WORK OF THE DEPARTMENT WITH SUGAR-BEET SEED.

The Department of Agriculture, realizing the importance of the foregoing facts to the beet-sugar industry of the United States, has undertaken to assist in the establishment of a pedigreed strain of sugar-beet seed and to determine the environmental influences of the different sections upon this strain. This work has been established in

connection with the New York experiment station at Geneva, N. Y.; the Michigan experiment station at Agricultural College, Mich.; the Utah experiment station at Logan, Utah; with private parties under Departmental supervision at Holland, Mich., and in cooperation with a large sugar-beet seed grower at Fairfield, Wash.

Experiments to determine the effect, if any, of various amounts of water applied at different times for irrigation purposes upon the permanent qualities imparted to seed are also being carried on at Logan, Utah, in cooperation with the experiment station there.

As the work on these lines has just commenced, no detailed or definite report can be given at this time. At each of these places a large number of roots have been most carefully selected according to physical properties and sugar content, and siloed. These roots, together with the seed raised this year from some selected and tested roots, will be planted the coming spring and seed will be raised in accordance with the methods practiced by the best growers in Europe.

The work at Fairfield, Wash., has been very encouraging, and during the last year a representative from the Department has spent his entire time there carrying on the work according to the most scientific and approved methods. He has analyzed several thousand individual roots, and these are now in silo at that place. These roots include 15 roots testing 24 per cent sugar in the beet, 50 roots testing 23 per cent, and 100 roots testing 22 per cent. In all, some 300 roots tested 21 per cent or more of sugar in the beet, and composite tests showed from 86 per cent to 91.9 per cent of purity.

From the best of these roots as well as from the best of those from the other stations, families will be bred from which the Department will furnish seed for breeding purposes to such seed growers or factory men as may desire it. This will require a number of years.

THE WEATHER BUREAU AND THE HOMESEEKER.

By Edward L. Wells,
Observer, Weather Bureau.

MOVEMENT OF POPULATION IN THE UNITED STATES.

In 1790 the center of population of the United States was in eastern Maryland; one hundred years later, in 1890, it was in southeastern Indiana, about 20 miles east of the town of Columbus; during the ten years from 1890 to 1900 it moved still farther westward, though, owing to the marvelously rapid growth of the large cities of the East, the great industrial awakening in the South, and the fact that most of the public domain available for immediate cultivation had been taken up prior to 1890, the distance covered was less than in any previous decade since 1810; and, notwithstanding these conditions, there is no doubt that the census of 1910 will show a continued westward movement of the median point of population. From 1890 to 1900 the population of Oklahoma increased from 61,834 to 398,331, or more than 500 per cent; Arizona's population increased from 32,052 to 63,598, or more than 98 per cent; while that of Idaho increased from 84,385 to 161,772, or almost 92 per cent. In Oklahoma, with a net gain in population of more than 300,000, there was a gain of less than 13,000 residents of foreign birth; Arizona's gain of more than 31,000 includes less than 5,500 of foreign birth; while the increase in foreign-born population in Idaho compared to the total increase is as 1 to 25. Thus, it is seen that by far the greater number of those who have gone to make their homes in the rapidly developing States and Territories of the West are from other portions of our own country.

The American people are a restless people; in the older countries the farmer is content to till the same soil from which his grandfather coaxed a living, haggling a little with landlord or steward, perhaps, about rent and improvements, yet with little thought of moving; but in our own country it is a rare thing to find a community where there have not been many changes in ownership and occupation within a generation. From the census of 1890 it appears that one in every five of the native-born inhabitants of the United States was at that time living in a different State from that in which he was born. The business of our cities is largely in the hands of farmers' sons, while men whose early lives have been spent in the city or town are

getting away and devoting their attention to agriculture; Northern men are developing the resources of the South, and Southern men are achieving distinction in the Northern States; Western men are making themselves felt in the business life of the East, while in the West the question, "From what part of the East do you come?" is taken as a matter of course.

WHY AMERICANS MOVE.

It is not within the province of this paper to discuss in detail the causes which lead up to the constant shifting of the population. Much of it is doubtless due to pure restlessness, a desire for new surroundings and new experiences; yet conditions often exist which make it advisable or even necessary for an individual or a family to leave familiar scenes behind and strike out to make a new home. A young man is often prompted by a desire to achieve prominence, and, believing in that peculiar perversity of human nature which led to the saying, "A prophet is not without honor save in his own country," becomes convinced that a way to the front is more easily won among strangers than among friends. Another may desire to devote his life to a certain business, trade, or profession which offers no opening in his own community. A class which probably includes a greater number of homeseekers than all the others just mentioned is made up of those who, on account of failing health, seek a location where climatic conditions are unfavorable for the development of the peculiar ailment to which they are subject. Still another class, and perhaps the greatest of all, comprises those who in old established communities have failed to acquire a competence; these, tired of paying rent for the privilege of tilling the soil of others are drawn westward and northward and southward (in recent years sometimes eastward), by the prospect of more readily securing holdings of their own. Current periodicals are filled with advertising matter addressed particularly to the classes just mentioned; transportation companies vie with one another in the issue of matter calling the attention of homeseekers to the advantages, climatic and otherwise, of the regions through which their lines pass or toward which they lead. Great land agencies and colonization systems have been built up, having representatives scattered throughout the more thickly settled portions of the United States whose business it is to turn the attention of homeseekers toward the districts which are being settled by these organizations, and fortunes of no mean proportion are being made out of the profits of this line of business.

MISTAKES OF HOMESEEKERS.

In many cases the homeseeker is benefited by the change, for some of the most desirable sections of the United States are still undeveloped, and the Western States and Territories, toward which the tide

of homeseekers is still so strong, are able still to care for all who come; yet there have been many instances in which the locating agent and the transportation company have been the only ones who have profited by the removal, and in which the homeseeker would have fared far better had he remained in his original location. Often, too, the settlers in an undeveloped or partially developed section are handicapped by a lack of knowledge of the climatic conditions peculiar to that section and of the crops most likely to prove profitable, so that years must be spent in experimenting. The writer well remembers some experiences of this character when in the eighties he removed with his father to a "claim" on the Great Plains, near the western limit of rainfall sufficient for successful farming without irrigation. From lack of knowledge of the conditions and how to meet them many of the pioneers of that section were reduced to want, while most of the original settlers gave up the attempt to wrest a living from the soil, and moved away to other sections of the country; hundreds of farms passed into the hands of the loan companies and thousands of acres of land went back to sod, leaving business almost paralyzed. However, a few of the pioneers remained; after a time other families came in to take the places of those who had gone; these profited by the mistakes of the others and by their own, and to-day the State which now includes that section takes high rank in the per capita production of wealth.

WEATHER BUREAU WORK OF BENEFIT TO HOMESEEKERS.

It becomes, therefore, a matter of the greatest importance to one who contemplates settlement in a new locality to have information relative to the climatic conditions existing in that locality, so that he may determine whether or not the change will be advantageous, and may make his plans to meet the new conditions and turn them to his profit. A source of such information is to be found in the records kept by the United States Weather Bureau and the reports which it issues.

CLIMATE AND CROP SERVICE.

When the Weather Bureau is mentioned, one naturally thinks of that part of the work of the Bureau which relates to the preparation of forecasts and their dissemination for the benefit of the public; and because forecasts sometimes fail of verification there are those, even now, who are of the opinion that the work of the Bureau has come to naught. It is true that the most important of the duties assigned to the Chief of the Weather Bureau and his corps of assistants is that of issuing forecasts and warnings, and the energy of the Bureau's best men is being turned in the direction of increased efficiency in this branch of the service. If no work were attempted other than that incident to the issue of forecasts, its existence would still be more

than justified. There is, however, another line of work carried on—the climate and crop service—which was taken up as an afterthought when the work of forecasting had been going on for some time; it is not yet so well known as that work, but is scarcely less important, and is likely to be of increasing value as time shall pass. Of the 190 regular stations of the Weather Bureau, 45 are designated as climate and crop service centers. Under the supervision of the official in charge of each of these centers is a climate and crop service section, usually comprising a single State or Territory, but in a few instances including two or more. In addition to the regular stations of the Bureau, at each of which is kept an accurate and comprehensive record of meteorological conditions, there are now in operation more than 3,000 voluntary observation stations, where records of temperature, precipitation, wind direction, cloudiness, etc., are kept by public-spirited persons, who make use of Government instruments loaned for the purpose, but who receive no pecuniary compensation for their services.

PUBLICATION OF INFORMATION CONCERNING CLIMATE AND CROP CONDITIONS.

At the close of each month each of the voluntary observers forwards to the section center a copy of his record for the month. These records are carefully revised at the section center to avoid the possibility of error; they are then summarized and published in neat pamphlet form, and in this form find circulation throughout the entire English-speaking world. These publications not only treat of the weather of the month, but also show how the various meteorological features of the month compare with the same features of the corresponding month in previous years; any weather event of unusual occurrence receives special notice, and the progress of the principal crops of the section during the month is noted. At the close of each year an annual summary is issued at each of the section centers, giving a history of the weather of the section during the year, and also the average values for the principal weather elements for all the years during which records have been kept.

During the season of growing crops the information made available by the work of the regular staff of the Weather Bureau and the 3,000 voluntary observers already referred to is augmented by weekly reports of crop conditions and progress as influenced by weather, forwarded by about 14,000 crop correspondents, most of whom are farmers, while all are in close touch with the agricultural interests of their respective communities, and are thus in a position to write authoritatively in regard to crops. From the information received from these crop correspondents weekly crop bulletins are prepared and published, both at the section centers and at the central office of the Bureau in Washington, D. C. These bulletins are issued free of cost to all who desire them, and the information which they contain

forms an excellent basis upon which to calculate which agricultural products can be successfully grown in any locality. A discussion of the climate and crop publications of the Bureau would be incomplete without mention of the Monthly Weather Review, the official organ of the Bureau, edited by Prof. Cleveland Abbe. In the preparation of the tables and charts appearing in the Review the reports from all regular and voluntary stations are used, and in the preparation of the special reports from the various section directors, which form a feature of every issue, consideration is given to the reports of the crop correspondents as well. This publication is on file in every Weather Bureau office in the service, and has a large and growing circulation elsewhere in this country as well as abroad. Numerous other publications are issued from time to time, treating of certain climatic features of the country or of the climate of a certain portion of the country. Among these may be mentioned Professor McAdie's work on the Climatology of California, a book of 270 quarto pages of printed matter, together with many excellent charts and illustrations. Under the direction of the Chief of the Bureau, Prof. A. J. Henry is now preparing a work on the Climatology of the United States, which is to contain, in a form convenient for ready reference, sufficient data to fairly represent the climatic conditions in all parts of the country.

While the data contained in the publications named cover the field so thoroughly that there would seem to be little need to seek further for climatic information, yet if more is desired the officials in charge of the various offices of the Bureau stand ready to furnish further details to the homeseeker, either by correspondence or by personal interview; indeed a very large percentage of the correspondence of many of the Weather Bureau offices, especially of those in the Western States, is with those who are contemplating a change of location. Prof. A. G. McAdie, in charge of the San Francisco office, states that probably over 30 per cent of his correspondence is with homeseekers. Mr. George N. Salisbury, section director for the State of Washington, says that, aside from the correspondence with the central office, about 50 per cent of his correspondence is made up of requests for climatic information, about 30 per cent of it being from those who contemplate settlement. What is true of these offices in this respect is also true of many of the southern and western section centers, and with each year the importance of this work is increasing.

In the offices located in the more thickly settled and better known portions of the country there is less correspondence touching on the subject of climate, but probably a great deal more information is given out by personal interview and by means of the published reports from other sections, as well as files of the Monthly Weather Review, all of which are to be found in the more important offices, suitably bound, for the use of the public.

These publications are constantly consulted by homeseekers. Out of a multitude of instances which have come within the experience of the writer a single one may be cited: A man who had become somewhat discouraged in the attempt to earn a livelihood as a carpenter, in the face of very unsettled industrial conditions determined to try his hand at farming. A circular had come under his notice calling attention in glowing terms to the advantages of a certain section in a Western State, where land was to be obtained at a low price; and so convincing was the argument that he seriously contemplated removing with his family to that locality and investing his savings in a farm. However, before doing so he visited the nearest office of the Weather Bureau and consulted the records and reports there on file; and, learning that in the locality toward which his attention had been turned certain weather conditions disadvantageous to his purposes were likely to occur, he abandoned the plan, which, if carried out, would probably haye resulted in the loss of all he had accumulated.

INDIRECT BENEFITS OF WEATHER BUREAU INFORMATION.

Enough has been said of the direct relation of the Weather Bureau to the homeseeker to show something of the important place which this branch of the public service is filling, but mention of the indirect relation must not be omitted. Reference has been made to the great volume of advertising matter distributed by various real estate, colonization, and transportation companies. While it must be confessed that such matter may often contain statements which do not stand the test of investigation, there is yet one feature of many of the circulars and booklets issued which can be depended upon, and that is the portion devoted to quotations from the records of the United States Weather Bureau, such data being furnished by the Bureau; indeed, many of the articles appearing in these advertising publications have been prepared in their entirety by officials of the Bureau. Individuals and corporations interested in colonization schemes are learning that an article of this kind inspires confidence in publications of the character mentioned, and the number of such articles which Weather Bureau officials are called upon to furnish is constantly increasing. Not only in publications intended primarily for homeseekers do such articles appear, but large use of them is made by the press, many newspapers giving prominence to articles treating of the climatic conditions prevalent in the sections where they find circulation, and of the agricultural products of those sections as well.

The work of the climate and crop service of the Weather Bureau is thus essential to the homeseeker, aiding him to select that portion of the country in which are to be found the climatic conditions best suited to his needs.

DETECTION OF COTTON-SEED OIL IN LARD.

By L. M. Tolman,
Division of Foods, Bureau of Chemistry.

DIFFICULTY OF DETECTING LARD ADULTERANTS.

The determination of the presence of small quantities of foreign fat in lard is exceedingly difficult, and taxes the skill of the chemist to the utmost. Most fats which are suitable or available for mixing are so similar to lard in their physical and chemical properties that the determinations which suffice to detect their presence when they occur in large amounts or to identify them in their pure state are of little or no value in detecting the small amounts usually employed in adulterated lard. As a result, the chemist must depend to a large extent on certain qualitative or approximatively quantitive tests. Many of these tests are not based on any inherent property of the fat, but depend on some impurity, due perhaps to the method of manufacture, or, with animal fats, to the kind of food upon which the animal has been fed.

FAILURE OF ORDINARY TESTS FOR COTTON-SEED OIL.

In this country cotton-seed oil is the cheapest fat available and is used to a great extent. A large amount of it is employed in making compound lard, which is generally a mixture of lard, tallow, and cotton-seed oil, and is usually sold as such under various trade names, but sometimes, perhaps by mistake, it comes on the market as pure lard. Hence, it is the detection of cotton-seed oil that is most often required of the chemist.

The need of evidence that lard is adulterated usually arises in prosecutions under a pure-food law, or in some other legal proceedings. The chemist must be able to say that the lard submitted to his inspection certainly has been adulterated—usually with cotton-seed oil—or his testimony leaves a doubt. A great number of tests for cotton-seed oil mixed with lard have been submitted, but practically without exception they have proved valueless. The two tests on which the chemist has chiefly based his decision as to the appearance of cotton-seed oil in lard are the Bechi reaction due to the reduction of silver nitrate and the Halphen test, a crimson color formed when the cotton-seed oil is heated with a little sulphur dissolved in carbon disulphid. But the

reactions in these tests appear precisely the same in the pure lard made from hogs fed on cotton-seed meal and in lard adulterated with a small amount of cotton-seed oil; and in so far the tests are failures.

Now, as a matter of fact there is little lard made from hogs fed on cotton-seed meal; for extensive investigations at the agricultural experiment stations have shown that while the meal is a rich, cheap food, it proves in many cases in an unexplained way a poison to the hogs, and so many of them die of eating it that few growers care to risk its use. But it is indisputable that some cotton-seed meal is fed to hogs and some of the lard may get on the market; and Mr. Elton Fulmer, of the Washington Agricultural Experiment Station, who has conducted extensive experiments in feeding hogs on the meal, has shown that pure lard from hogs so fed will give as strong tests for cotton-seed oil as lard mixed with 15 per cent of the oil itself.

So although there is little likelihood that lard from hogs fed on cotton-seed meal would be involved in any litigation, nevertheless a doubt is cast upon the ordinary tests which makes them of very little value in legal proceedings. In every authentic case on record in which they have been applied to the products of the large packing houses and the reaction for cotton-seed oil has been obtained, the manufacturers have taken advantage of the difficulty of proving whether this result was due to the actual presence of cotton-seed oil or to the feeding of the meal to the animals from which the lard was made.

A NEW TEST SUCCESSFUL.

Recently a study of the nonfatty substances which occur in the lard and cotton-seed oil was made by Bömer, with the hope of finding a method of detecting such adulterations with certainty, and he has developed a very satisfactory and exceedingly delicate process for determining the presence of any vegetable fat in lard.

BASIS OF METHOD WITH DETAILS OF DETERMINATION.

This method depends on the fact long known that there is present in all vegetable fats, but not in pure animal fats, a small amount of a certain alcohol, phytosterol, which has a definite crystalline form, as shown in Plate XL, figure 1, and a definite melting point. These crystals are in general described as "needle shaped," and at the end form an angle of 108°. On the other hand, in animal fats there occurs another alcohol, cholesterol, which has a different melting point and an entirely distinct crystalline form, having the appearance of thin rhombic plates, as shown in Plate XL, figure 2. Mixtures of phytosterol and cholesterol produce crystals entirely different from either one of these, being telescopic in shape and easily recognized under the microscope. In Plate XLI, figure 1, are shown the crystals formed by mixing 75 per cent of cholesterol and 25 per cent of phytosterol.

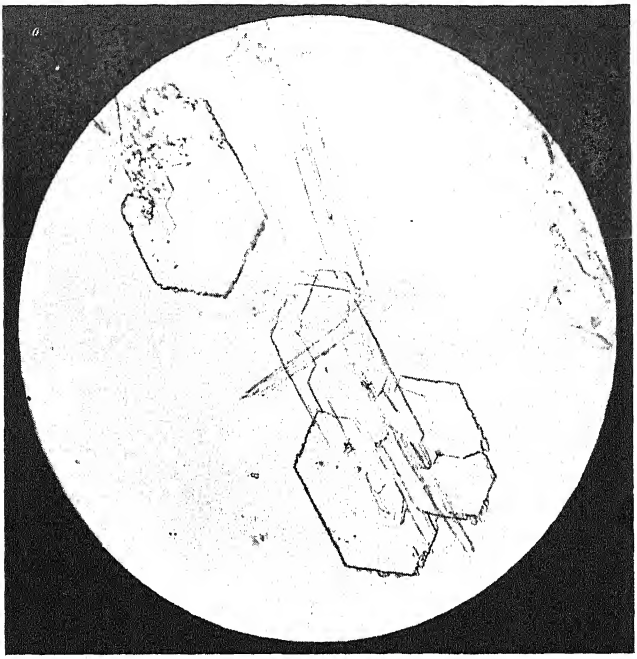


FIG. 1.—PHYTOSTEROL CRYSTALS FROM COTTON-SEED OIL. × 70.

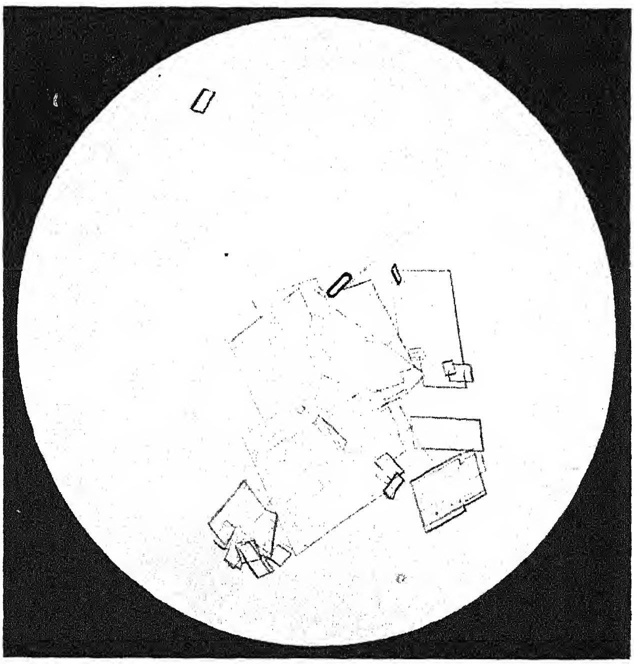


FIG. 2.—CHOLESTEROL CRYSTALS FROM LARD. × 100.

[Photomicrographs made by B. J. Howard.]

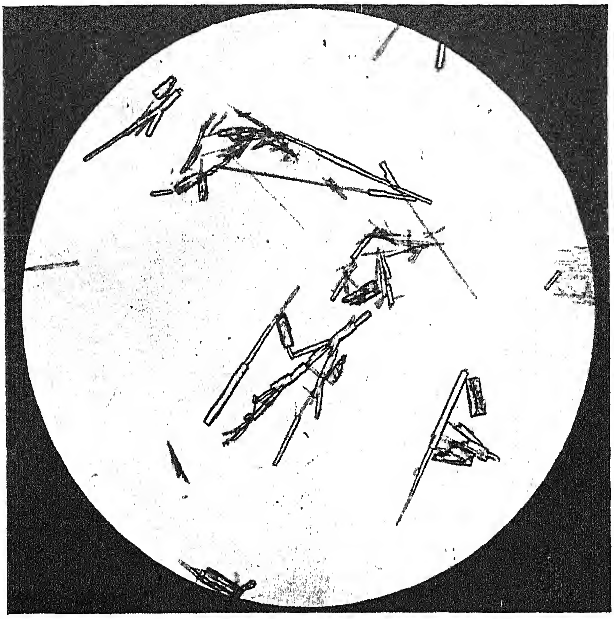


FIG. 1.—CRYSTALS RESULTING FROM A MIXTURE OF 75 PER CENT CHOLESTEROL AND 25 PER CENT PHYTOSTEROL. × 100.

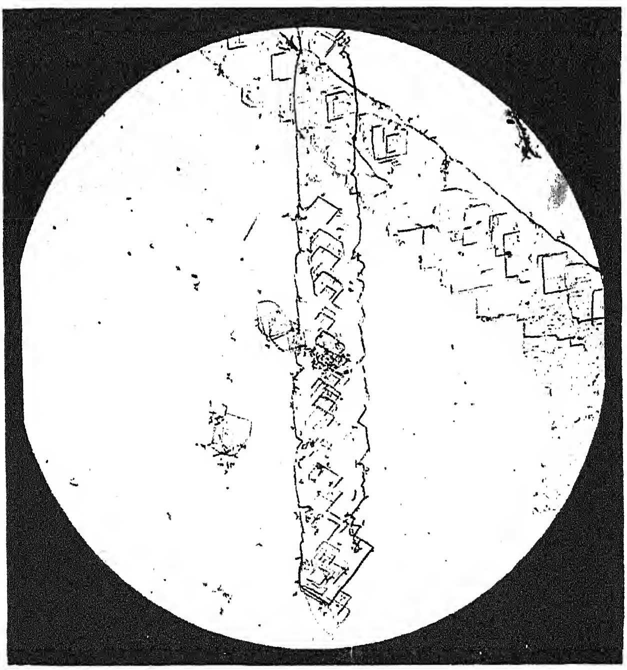


FIG. 2.—CRYSTALS RESULTING FROM AN ADDITION OF 5 PER CENT OF COTTON-SEED OIL TO LARD. × 65.

[Photomicrographs made by B. J. Howard.]

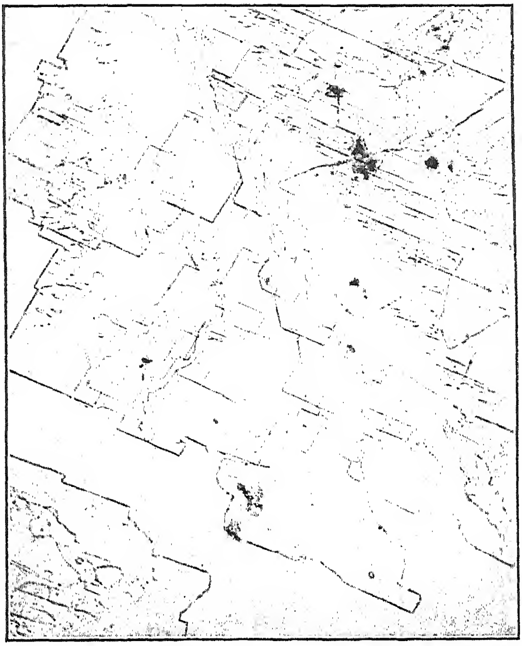


FIG. 1.—CHOLESTEROL CRYSTALS FROM PURE LARD OF COTTON-SEED FED HOGS. × 90.

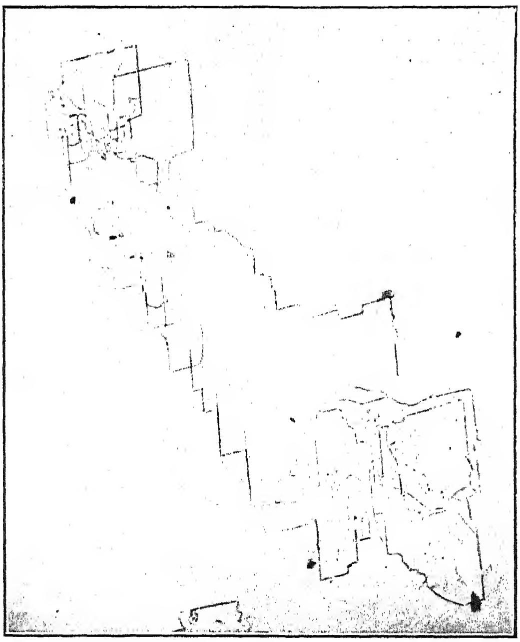


FIG. 2.—A SECOND PLATE OF CRYSTALS SHOWN IN FIG. 1. × 90.

[Photomicrographs made by B. J. Howard.]

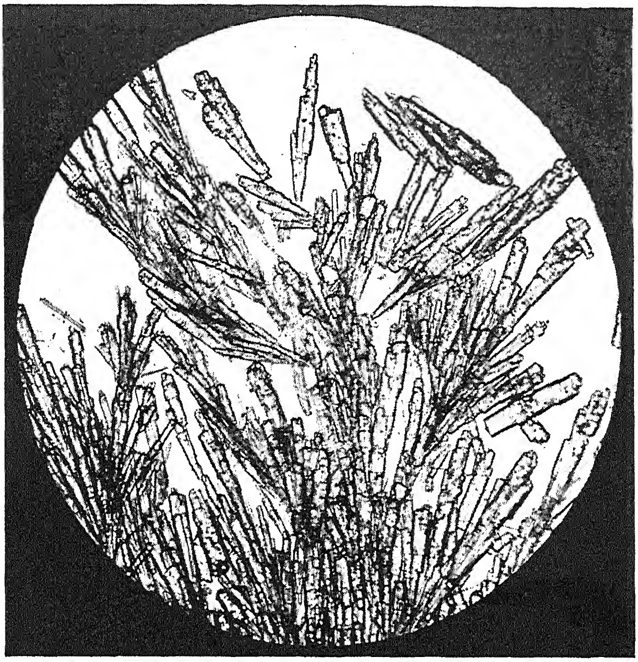


FIG. 1.—CRYSTALS OF LARD TO WHICH 10 PER CENT OF COTTON-SEED OIL WAS ADDED. × 100.

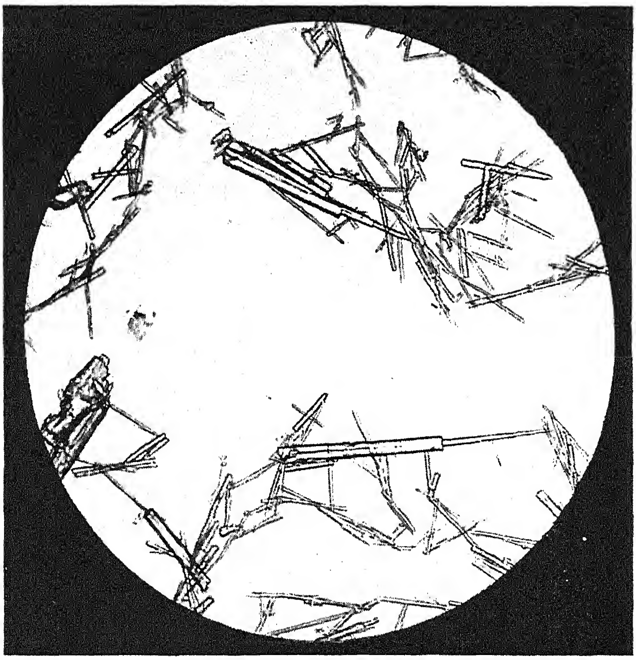


FIG. 2.—CRYSTALS OF LARD TO WHICH 10 PER CENT OF HEATED COTTON-SEED OIL WAS ADDED. × 200.

[Photomicrographs made by B. J. Howard.]

These telescope-shaped crystals have not been found in animal fats. As cotton-seed oil contains 0.6 per cent of phytosterol and lard about 0.3 per cent of cholesterol, a mixture of 14 per cent of cotton-seed oil and 86 per cent of lard would give about the percentages of cholesterol and phytosterol shown in Plate XLI, figure 1. These peculiar telescopic forms of crystals are obtained with as little as 12 per cent of phytosterol and 88 per cent of cholesterol, or about 6 per cent of cotton-seed oil and 94 per cent of lard.

Smaller amounts of cotton-seed oil can be recognized under the microscope by the forms of the crystals, as shown in Plate XLI, figure 2, where 5 per cent of cotton-seed oil had been added to a lard; but it is not safe to depend on the microscope where so little of the oil is used. The melting point of the acetates must be used for the detection of from 2 to 4 per cent of cotton-seed oil. These are prepared by heating the alcohols with acetic anhydride and crystallizing. Cholesterol acetate from pure lard has a melting point of 113° to 114° C., while the alcohol from lard containing 2 per cent of cotton-seed oil gives an acetate with a melting point of 116° C., and 4 per cent raises it from 118° C. to 119° C.

Thus a method is formulated by which small amounts of cotton-seed oil may be detected, and which possesses the great advantage over other tests that it has a scientific basis and is not affected by methods of manufacture nor accidental impurities.

AN IMPORTANT QUESTION FINALLY SETTLED.

The question is at once raised, however, on account of the peculiar results in all other tests when lard from hogs fed on cotton-seed meal is tried, whether phytosterol might not pass into the animal fat and thus the method be vitiated. Now, it is a well-established fact that no phytosterol, but only cholesterol, occurs in animal fats; therefore none of the phytosterol which is in plants enters into the fat of the animal which feeds upon them. For example, the hog fed on corn or other cereals takes considerable quantities of phytosterol into its digestive tract, but there is no record of phytosterol being found in the lard. As most plants contain phytosterol and most animals eat plants, the failure to find phytosterol in numerous tests for it produces a high probability that phytosterol of plants does not pass into the fat of animals. So we should not expect the phytosterol of cotton-seed meal to act differently.

But in order to settle so important a matter experimentally, a number of samples of lard from hogs fed on cotton-seed meal at the Washington experiment station were obtained by the writer from Mr. Fulmer. These lards all gave the usual color tests that would be given by products containing added cotton-seed oil, varying only in degree, as though from 1 to 15 per cent of cotton-seed oil were present.

Accordingly, as far as these ordinary tests showed, these lards were to be considered adulterated with cotton-seed oil. But the examination of the alcohols present gave a very different result. The process of crystallization was like that of other pure lard, and the microscopic examination showed the crystals to be cholesterol.

In Plate XLII are shown the crystals from a lard known to be pure, which gave as strong a color test with the Halphen reagent as would be given if 10 per cent of cotton-seed oil had been present, and Plate XLIII, figure 1, shows the crystals from a lard to which 10 per cent of cotton-seed oil had been added. In the former case are seen the peculiar plate-like crystals which give every indication of being pure cholesterol, and can not be distinguished in any way from the cholesterol of other pure lards, or from pure tallow, or from cholesterol prepared from gall stones. On the other hand, in Plate XLIII, figure 1, are seen the peculiar telescopic crystals found in a mixture of cholesterol and phytosterol, as was shown in Plate XLI, figure 1.

The more delicate test for the presence of the phytosterol, that of the melting point of the acetate, was also applied to all the samples of pure lard from cotton-seed fed hogs, and the melting point was found to be from 113° to 114° C. The cholesterol from tallow gave an acetate melting at 114° C., and the cholesterol from gall stones an acetate melting at 114° C. This shows that the alcohol of these lards is pure cholesterol, and that this method enables us to distinguish between adulterated lards and pure lards which give the cotton-seed reactions because of feeding cotton-seed meal.

DETECTION OF COTTON-SEED OIL AFTER CHANGE BY HEATING.

Another, and perhaps more important, feature of the value of this test is that it may be used in detecting cotton-seed oil in lard not affected by feeding on cotton-seed meal, but in which other tests for the oil fail for another reason. This reason is that cotton-seed oil after being heated to about 250° C. for twenty minutes does not give any of its characteristic reactions, so that if such an oil were used in adulterating lard it would not be detected by the ordinary tests. But heating does not affect the phytosterol in the oil. In Plate XLIII, figure 2, are shown the crystals from a lard mixed with 10 per cent of a heated cotton-seed oil, which did not respond to either the Bechi or the Halphen tests, but there is no difficulty in detecting the adulteration by the new method, as the same peculiar telescopic crystals shown in figure 1 of Plates XLI and XLIII are present. The melting point of the acetate was also 120° C., showing conclusively the presence of considerable quantities of phytosterol.

Thus, it is seen that this method enables the chemist to detect cotton-seed oil in whatever form it may be present, and that it is not affected by any method of feeding or any process of manufacture.

SOME USES OF THE GRAPEVINE AND ITS FRUIT.

By George C. Husmann,
Viticulturist, in Charge of Viticultural Investigations, Bureau of Plant Industry.

INTRODUCTION.

Perhaps no plant and its products are used in so many ways and for so many purposes as the grapevine and its fruit. Many of these uses are of ancient origin, owing no doubt to the fact that few plants grow and thrive under climatic and soil conditions so varied or respond to care and attention more generously than does the grapevine. Thus, we find certain forms of it in the natural state aspiring to overtop the mightiest monarchs of the forest and single plants overspreading areas hundreds of feet in circumference, while other forms are grown under cultivation as mere bushes, 2 or 3 feet in height, yet yielding crops ranging from 1½ tons to as much as 22 tons of the finest fruit to the acre.

By nature the "vine" is evidently a great rambler. Pliny states that because the vines in Italy climbed to the tops of the highest poplars the grape gatherers in vintage time stipulated with the master that in case their feet should slip and their necks be broken he was to order and pay for the funeral pyre and tomb.

The cultivation of the vine was the highest achievement of ancient husbandry, the vine and olive being, in antiquity, the marks, and almost the symbols, of settled and cultured life. Profane history does not reach back to the first plantings or the first wine made from the grape. It is interesting to note that grape seeds have been found with the remains of Swiss and Italian lake dwellers, in European graves of the Bronze Age, and in the tombs of the Egyptian mummies. The vine is frequently the subject of metaphor in the Scriptures—to dwell under the vine and fig tree is emblematic of happiness and peace. We enjoy the grape in the fresh state, or, when dried, in the form of raisins or "currants;" the unfermented juice and wine are important items in household economy and medicine, while from the grape many other products and by-products are made. The vine itself gives pleasure to the senses by its fragrant blossom, beautiful foliage, and luscious fruit; it affords shade and shelter; various parts of it are employed for divers medicinal purposes; and the wood is used for fuel and in the manufacture of furniture and other useful articles. In fact, there is no part of the vine or its fruit that has not proven of value for one or more purposes.

In Switzerland the leaves are applied to medicinal or surgical uses. For cuts and fresh wounds they are esteemed a sovereign remedy. Decoctions of the juice of the leaves are used in poultices. An agreeable tea is also made from the leaves which is said to greatly strengthen the nerves. In its use more sugar is necessary than for tea from the tea plant. The leaves are also excellent food for cows, sheep, and hogs. The "tears" of the vine, used medicinally, are a limpid exudation of the sap at the time the plant begins budding, and are found on

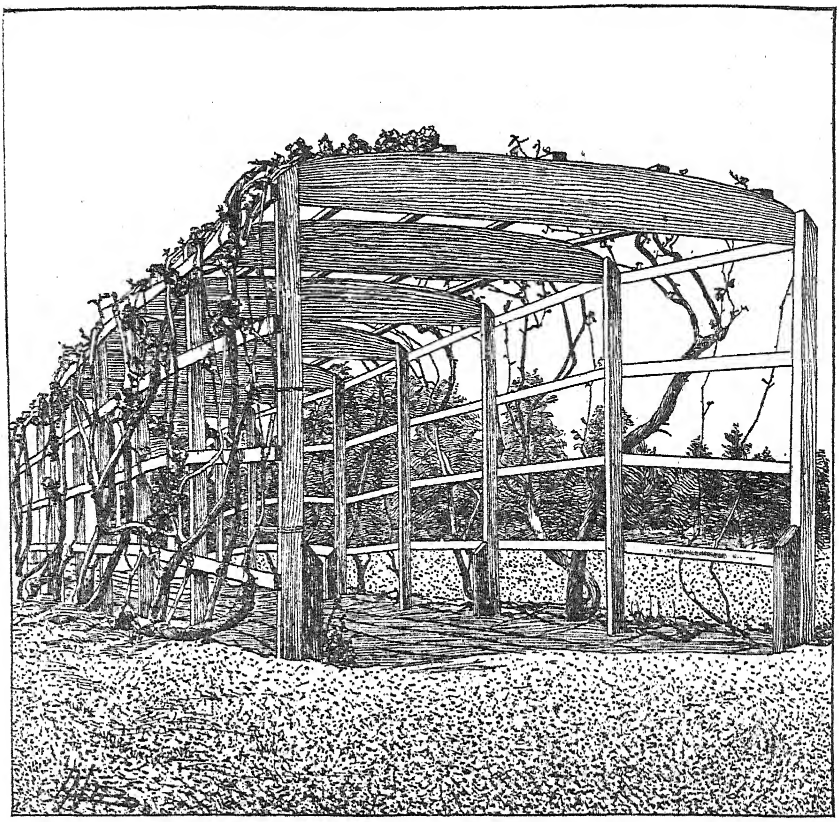


FIG. 38.—Grape arbor, Fresno, Cal.

the vine where the slightest wound occurs to the plant. The liquid is collected by cutting off the ends of the canes, bending them down and sticking the ends into the neck of a bottle, which will be filled in a few days. The wood and branches are used in the manufacture of baskets, furniture, rustic work, bark for tying material, etc., and when burned furnish potash and salts.

The wood of the grape is said to be of the most lasting nature, very beautiful in its texture. The columns of Juno's temple at Metapont and also the statue of Jupiter at the city of Appolonium were made

from the wood of the vine. The great doors of the cathedral at Ravenna are made of vine planks, some of which are 12 feet long and 15 inches broad.

Aside from their economic value, vines are often cultivated for purely ornamental purposes, owing to their beautiful foliage and the rich coloration they assume, the shade they afford, and their hardihood and longevity. The vine is one of the few plants that can be conveniently grown in cities or towns either as bushes or for making delightful arbors (fig. 38) that not only beautify the home, but furnish cooling shade and luscious fruit. The more tender sorts can be grown in graperies (Pl. XLIV, fig. 1) in many regions with good profit, and when grown in pots not only serve as handsome decorations in the dwelling and on the table, but add one of the choicest of morsels to the menu as well. To quote the language of an enthusiast:

> The grape is the poor man's fruit, especially one who has only a house lot of the smallest possible dimensions. He can plant vines beside his cottage and their roots will extend and profitably occupy every inch of ground underneath it, and from that small space produce all the fruit his family can consume, while the vines afford shade and protection and add beauty to his little home, occupying no space, either above or below the ground, to interfere with other interests, and producing more fruit in less time and with less labor and attention than anything that was ever planted.

AGE OF GRAPEVINES.

It is difficult to accurately estimate the age of vines by the usual method of counting the rings, because the yearly growth is not distinctly marked. Some authors state that the vine equals, and even surpasses, the oak in point of age. In America we have been unable to ascertain the age that planted vines will attain, and the time that has elapsed since its discovery would not be sufficient had the experiment been begun when Columbus landed in 1492.

Pliny mentions a vine 600 years old. Miller tells us some of the vineyards of Italy held good 300 years and that vines 100 years old were accounted as young. Professor Bosc states that some of the vines of Burgundy were 400 years old and more. It is more than likely that the advent of the phylloxera will have a tendency to shorten these age records in the case of the European and other non-resistant species. Doubtless there are native vines of much greater age. The writer has never seen a vine among the endless number of natives that abound in our forests that died from the effects of age.

SOME LARGE VINES.

Stephen Schultz says:

> At Beitdjin, a village near Ptolemais, we took our supper under a vine, the stem of which was nearly a foot and a half in diameter, the height about 30 feet, and it covered with its branches a hut more than 50 feet long and broad.

The celebrated vine in the conservatory at Hampton Court, England, planted in 1769, had in 1830 a stem 13 inches in girth and a principal branch 114 feet in length, the whole vine occupying more than 160 square yards; and in one year it produced 2,200 bunches of fruit weighing on an average a pound—in all, about a ton of fruit.

A wild grapevine upon the shores of Mobile Bay about 1 mile north of Daphne, Ala., is commonly known as the "General Jackson vine," from the fact that Gen. Andrew Jackson twice pitched his tent under it during his campaigns against the Seminole Indians. This vine in June, 1897,[a] was reported to have a circumference of 6 feet 1 inch at its base. Its age was estimated at that time to exceed 100 years.

A vine now standing in California, which is considered the largest in the world (Pl. XLIV, fig. 2), was planted in 1842 by a Spanish woman. Beneath its spreading branches, which cover nearly half an acre, 800 persons could find protection from the sun's heat. The first election in Santa Barbara County under American rule was held beneath its ripening fruit. The vine is of the Mission variety. In 1893 it bore 8 tons of grapes, and in 1895 over 10 tons. The trunk of the vine is 7 feet 8 inches in circumference. It is now owned by Jacob Wilson, of Carpinteria, Cal.

GRAPE GROWING IN ITS INFANCY.

The early attempts at grape growing on the Atlantic coast were generally unsuccessful, having been confined almost exclusively to the introduction and growing of European varieties. It has only been since attention has been given to improving and cultivating our native grapes and to counteracting the injury of insects and vine diseases that grape culture in that region has gradually developed into an important industry.

It will be of interest here to note that not only has America, in improving and cultivating her native grapes, given to the world a new fruit, but it has been the direct means of reestablishing the European vineyards upon stocks resistant to the attacks of the phylloxera or root-louse, which has already destroyed a large portion of the vineyards of the Old World. All the successfully reestablished vineyards are either American varieties or those of American parentage, or hybrids of these and Viniferas, or Vinifera varieties grafted on such sorts. In California, where the Viniferas have found a congenial home, and which bids fair to surpass any like area of the world in grape production (for, while in Europe they produce 150 to 400 gallons of wine to the acre, in California it is quite common for the production to reach five times that amount and even more), there has been a similar experience. Thousands of acres have already been destroyed,

[a] Letter from A. M. Valerio, Daphne, Ala., June, 1897.

FIG 1.—INTERIOR OF GRAPERY, DEPARTMENT OF AGRICULTURE.

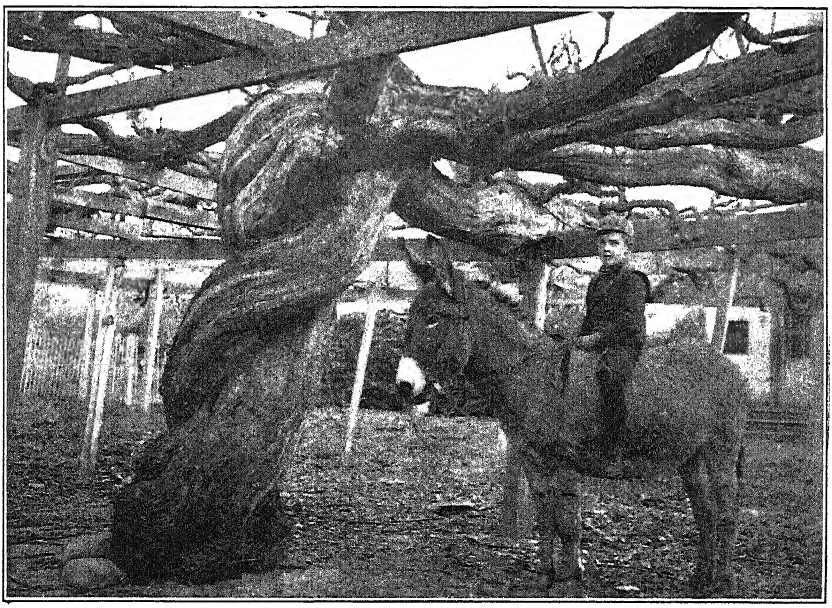


FIG. 2.—LARGEST GRAPEVINE IN THE WORLD.

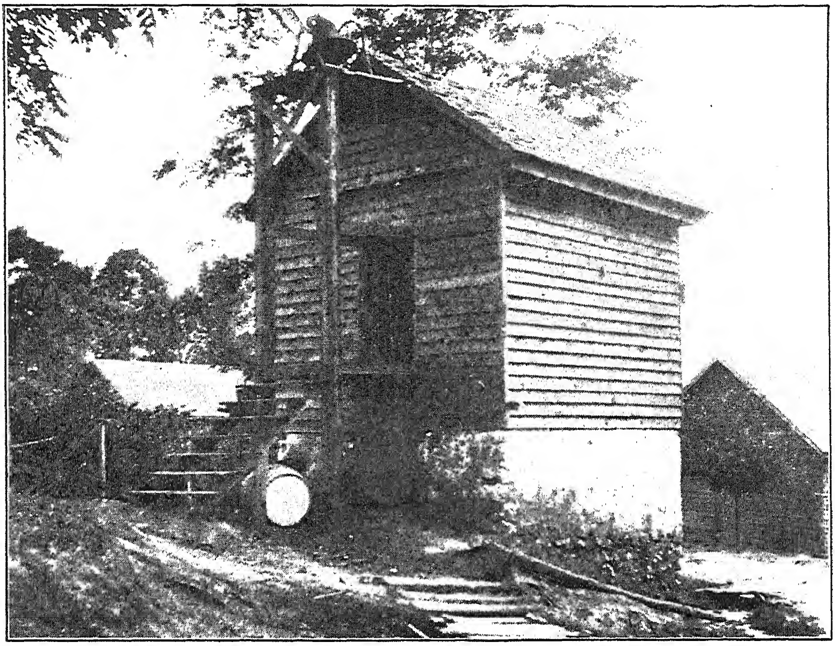


FIG. 1.—SCUPPERNONG WINERY, WELDON, N. C.

FIG. 2.—PICKING AND DRYING RAISINS IN CALIFORNIA.

and these, in order to be reestablished and become permanent and lasting vineyards, will have to be grafted on resistant stock.

It should also be stated that the industry in this country is in its infancy. Our successful experience has nearly all been during the last half century, and we have every reason to feel elated over what has already been accomplished. Many phases of the development have, however, scarcely been commenced. The Scuppernong (*Vitis rotundifolia*), for instance, a native species, perhaps more immune to disease and insect injury than any other, needs very little care and cultivation to produce enormous crops on suitable lands, of which there are thousands of acres now idle along the Atlantic coast and in the Gulf States. From this, a large and profitable industry can be developed. (Pl. XLV, fig. 1.)

GROWING OF GRAPES IN GRAPERIES AND IN POTS.

The growing of grapes in graperies (see Pl. XLIV, fig. 1) furnishes quite a source of revenue in some countries, notably Belgium and the Channel Islands, where large quantities are annually grown and exported, the United States being a good customer for them, as high as 35 cents to 75 cents per pound wholesale, and $2 to $3 and even more per pound retail, being paid for the fruit. Grape growing in pots is much practiced in parts of Europe, and especially in France, where these are largely used for decorative purposes on festive occasions.

The keeping of grapes in cool storage is deserving of more extensive practice and development. Shipping and keeping grapes in cork dust is quite an industry in some of the European grape districts, and a considerable quantity of such grapes, shipped from Spain, are annually consumed in this country.

THE GRAPE INDUSTRY.

The last decade of the first half of the nineteenth century witnessed the establishment of commercial grape culture in the United States on a firm foundation. A beginning was made in the manufacture of choice wine from American grapes on the Atlantic coast, the choicest Vinifera varieties were introduced on the Pacific coast, and wine made therefrom showed the pioneers of California that they could at no distant date enter into direct competition with Europe in the production of the choicest wines on the globe. It is to be regretted that so many of the choice wines produced have been sold under foreign labels of late years, there being but few of the better firms that have striven to make a reputation on their choicest wines, and the catering of the heaviest distributers to the cheaper trade has resulted in eliminating, to a very great extent, the growing of the choicer, less productive

varieties of grapes; hence, a tendency toward producing quantity at the expense of quality. In 1850 the country produced 250,000 gallons of wine. In 1860 the product had reached over 1,500,000 gallons, and all the States and Territories, except four, were growing grapes. The census of 1860 showed California, New York, and Ohio as the three leading wine-producing States. From 1860 to 1875 rapid progress was made. In 1870 Missouri produced more than any other State except California. With this exception, California, New York, and Ohio have been in the lead. According to the last United States census (1900), twelve States reported having over 2,000,000 vines each in bearing, and the following table (though the figures are only approximations) is sufficient to give a clear idea of the relative importance of these States as grape producers:

Number of grapevines in the leading producing States.

State.	Vines.	State.	Vines.
California	90,686,458	Missouri	3,546,319
New York	29,636,216	Oklahoma	3,542,034
Ohio	13,772,800	Illinois	3,008,888
Kansas	5,762,700	Indiana	2,570,579
Michigan	5,232,450	Georgia	2,376,904
Pennsylvania	4,711,039	Iowa	2,072,101

Upward of 250,000 acres are devoted to grape culture in California (see Pl. XLVI), which State produces more than two-thirds of the entire grape output of the country, the annual production of wine being over 30,000,000 gallons.

At a conservative estimate the raisin and wine industries of California, in vineyards, cellars, cooperage, distilleries, machinery, and capital to carry on the business, represent an investment of at least $85,000,000.

The dry and sweet wines produced in the last ten years amount to 255,000,000 gallons, an annual average of 25,500,000 gallons, and the brandy produced during the same time amounted to about 26,850,000 gallons.

The raisin production of California for the last decade has been about 895,000,000 pounds, an annual average of 89,500,000 pounds. The shipments of California-grown grapes to States farther east for the last ten years have amounted to 10,482 cars, or about 251,568,000 pounds, an annual average of 25,156,000 pounds. In 1903, on account of the short crop in the Eastern States, the shipments were greatly increased, there having been over 1,800 cars shipped. In 1904 more than 1,450 cars were shipped. About 50 per cent of the grape crop in California is converted into wine and 35 per cent into raisins, while 15 per cent is shipped as fresh grapes.

The foregoing figures give some idea of the grape industry in California, not yet fifty years old. While California has from the first proved a congenial home for Vinifera, or European grapes, New York leads by far in the production of grapes from American varieties, not only for shipping purposes, but also for wine, both dry and sparkling, and for unfermented grape juice. Of unfermented grape juice (see fig. 39) the Chautauqua district produces not only more than any other district, but more than all the rest of the country, 325,000 gallons having been made there in 1903 and 605,000 gallons in 1904.

Of the 169,055 gallons of sparkling wine produced in this country, according to the United States census in 1900, Missouri reported 2,940,

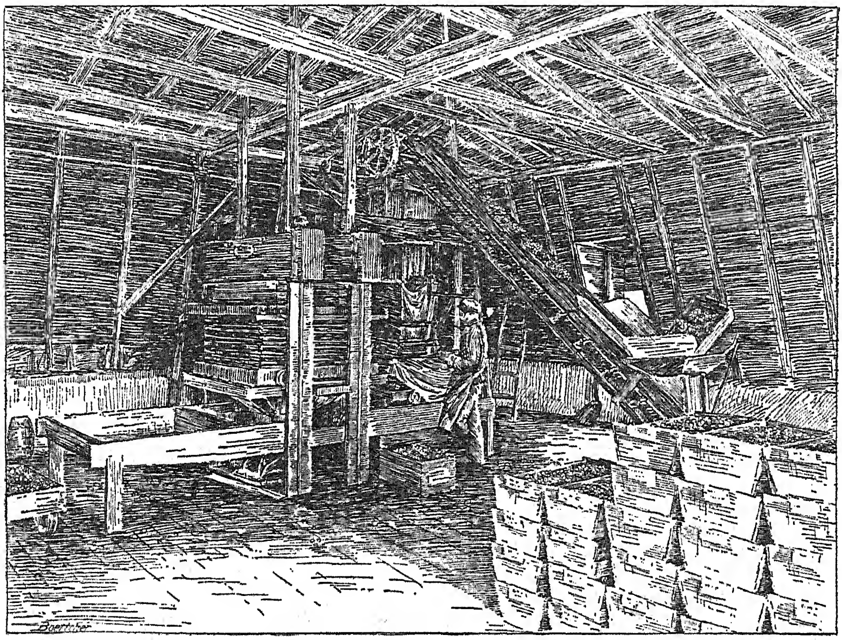


FIG. 39.—Crusher and hydraulic press, Hammondsport, N. Y.

California 8,880, Ohio 15,600, and New York 113,435 gallons. This shows New York to have produced more than twice as much sparkling wine as all the other States together. The wine yield of New York this year (1904) is estimated at 3,500,000 gallons.

The paramount object in the culture of the grape in most parts of the world has been the obtaining of wine. The extent of this will be surprising and hardly believed by those not acquainted with the statistics. Thus, for instance, there are annually produced on the globe over 4,000,000,000 gallons of wine. Of this amount, the United States produces only about 50,000,000 gallons.

WINES.

Dry wines in common parlance are understood to be those in which the sugar of the grape has through fermentation been converted into alcohol. These naturally divide into two groups, namely, red wines, such as Clarets, Burgundies, etc., and white wines, such as Rieslings, Hocks, etc.

Red wines are made from colored grapes; a few varieties have colored juice, but in most varieties the coloring matter is in the skins and is extracted from them during fermentation. The grapes are crushed (and in nearly all modern establishments stemmed) and put in fermenting vats, or casks (see figs 40 and 41), where, in order to develop

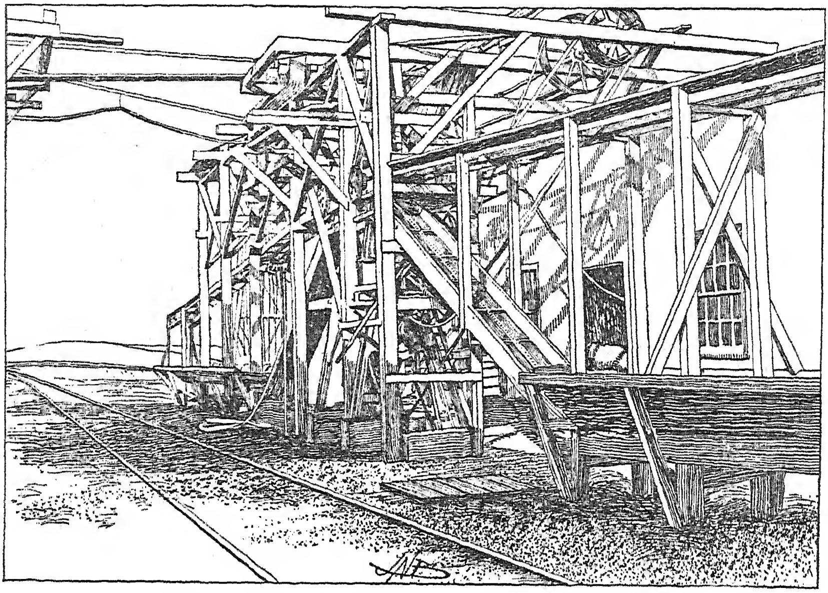


FIG. 40.—Crusher, stemmer, and must pump, Cucamonga, Cal.

the color as well as to extract certain ingredients that give red wines their value, the crushed grapes are fermented—skins, pulp, and juice together. The use of selected yeast cultures to start and correct fermentation, as well as to improve the quality of the wine made, is destined to become an important factor in dry-wine making. The juice is not drawn off until the first fermentation is completed. In order that fermentation may be uniform the entire quantity in a tank should be crushed the same day. The vats should not be more than three-fourths full, else they are apt to run over during fermentation. The fermenting tanks are generally made of wood, although masonry is sometimes employed. Tanks made of either of these materials, before being used, should be carefully cleaned and before being used for the first time should be steamed for several hours. The size and

FIG. 1.—SECTION OF 3,000-ACRE CALIFORNIA VINEYARD.

FIG. 2.—HAULING GRAPES AT WOODLAND, CAL.

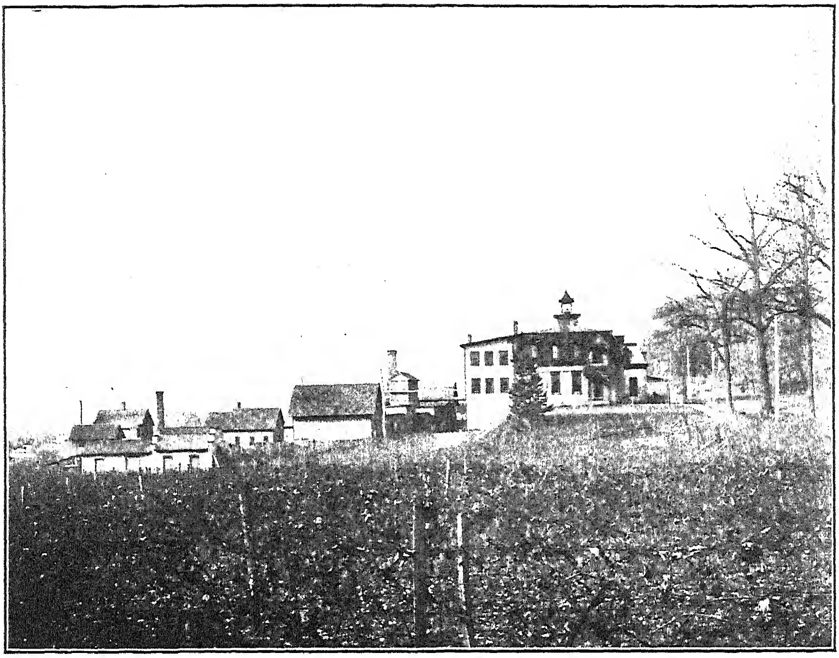


FIG. 1.—WINERY AT HAMMONDSPORT, N. Y.

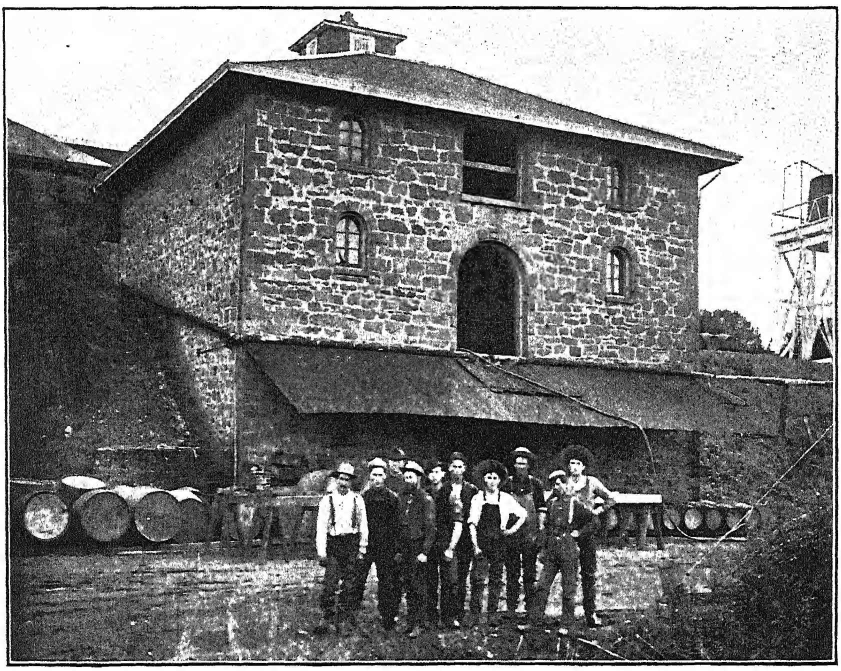


FIG. 2.—WINERY AT CLAYTON, CAL.

number of the vats used will depend upon the quantity of grapes crushed per day. The vats vary in size from 100 to 10,000 gallons or more each. Enough of them should be provided so that, when wine making has commenced, it can be carried on without interruption until the grapes are all crushed. The tanks are set on skids, raising them about 20 inches above the floor of the room, and are set slightly higher in the rear so as to permit them to be easily drained from the front through a faucet inserted in a hole bored 2 or 3 inches above the bottom of the tank. A coarse strainer of some kind should be put over this hole on the inside of the vat, before it is filled, so as to keep back the pomace while the juice is being drained. Quite a diversity of opinion

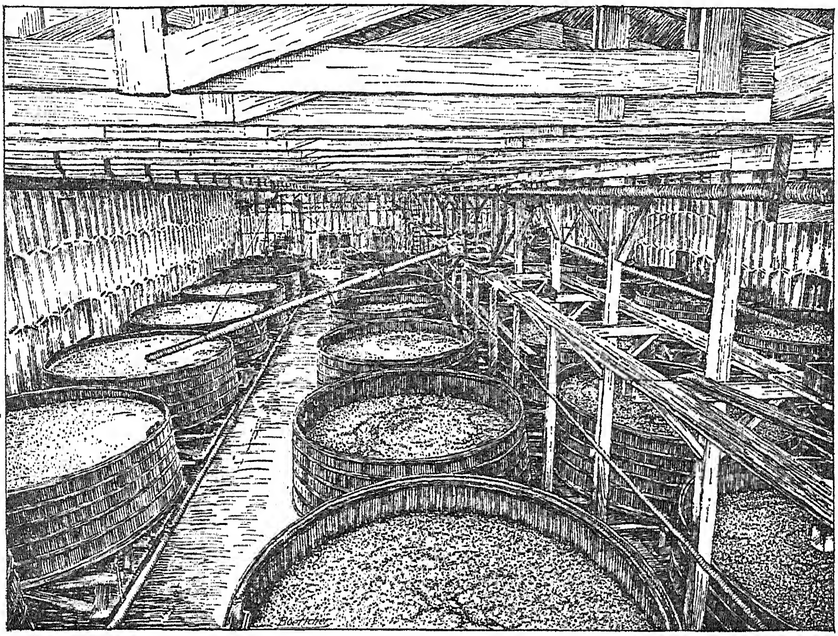


FIG. 41.—Fermenting room, Fresno, Cal.

exists among makers of excellent wine as to whether it is best to ferment in an open vat, a vat loosely covered, or a vat hermetically sealed, having a safety valve or pipe discharging the carbonic-acid gas into a vessel of water, thus completely preventing contact with the air; also as to whether it is better to have false heads resting directly upon and fastened over the pomace or to stir the pomace. Good wines are made by either method.

As soon as the active fermentation is completed, the new wine should be drawn from the pomace and be put into closed or storage cooperage and stored in a suitable building, having as even a temperature as possible, the best temperature for this purpose being about 60° F. (Pl. XLVII.) The pomace remaining after the juice is drawn off is

pressed, and the wine obtained from it is often mixed with that previously drawn off. In well-conducted and larger establishments, however, the press wine, on account of its being coarser and of inferior quality, is not mixed with the other wine, but is usually distilled. After the wine has been filled into storage cooperage (such as puncheons, casks, or tanks) a slow fermentation, called the secondary or insensible fermentation, goes on, bubbles of gas are given off, and the sediment settles to the bottom. While this is taking place the casks should not be tightly bunged or they will burst. The bung holes should be loosely covered by an inverted bung, a small bag of sand, a vine leaf, or something of the kind, so that the gas may escape. Bungs have also been invented for this purpose. During this time, while the wine cools and settles, it is necessary that the cooperage be kept entirely full or the wine will spoil. During the first week they should be filled up every day, the next week every two days, later on once a week, and finally, when fermentation is over, once or twice a month. As soon as the wines have settled they should be racked in clean cooperage in order to rid them of the sediment. After this they are usually racked again about December, then again ir early spring, and before the vintage in the fall.

White wines are made from white grapes and such varieties of colored grapes as have practically colorless juice, the color being in the skin of the berry. The making and handling of white wine is very similar to that of red wine. The chief difference consists in the fact that, instead of allowing the crushed grapes to go through fermentation in the fermenting vats, when made from white grapes they are either allowed to remain there only a limited time (usually not more than twenty-four or thirty-six hours), or (as is most common) they are pressed at once and the juice is filled into storage cooperage and fermented by itself, the receptacles being only about three-fourths full. When white wine is made from colored grapes, in order to prevent the juice taking color from the skins, the grapes, after being crushed, must be pressed immediately. White wines, therefore, are usually not only free from the coloring matter contained in the skins, but also from the ingredients found in red wines, which are extracted from the pomace during fermentation.

The sweet wines generally produced in this country are those in which none, or only a part, of the sugar in the grape has through fermentation been converted into alcohol, the fermentation being prevented or checked at any desired stage by the addition of grape brandy. This adding of alcohol to stop fermentation is called "fortifying." Of the sweet wines, ports and angelicas are the two kinds most largely produced and consumed in this country, and to describe briefly how these are made will practically illustrate how to make the other sweet wines as well.

Wines of the port type are made by taking colored grapes and crushing and putting them in fermenting vats to ferment the same as for making red wines. As soon as fermentation has reduced the sugar in the must to the desired point (during which fermentation color and other matters have also been extracted from the pulp and skins), the juice is drawn off, put in storage cooperage, and fortified.

For angelicas the grapes are crushed and pressed at once and the juice put in packages and fortified at once, or in such cases where the grapes are sweeter than is desired to make the wine, the juice is allowed to ferment down to the required point, and is then fortified. In fortifying any kind of sweet wine, care must be taken to put the alcohol in the cooperage first and the juice afterwards, as the alcohol rises through the must to the top as it fortifies. Were the alcohol to be put on top it would stay there and not fortify the must at all. Where hose and force pump are at hand the alcohol can be forced to the bottom of the must and the same object accomplished.

Sweet wines usually clear quickly, and in from two to four weeks should be ready to rack the first time. These are the kinds of wines most largely produced and consumed in this country.

Limited space prevents description of methods of making wines of the types of champagne, sherry, etc.

It should here be stated that as wine making is an art, little more than the general underlying principles can be stated. Skill in the making and care of wine must be acquired by actual experience. There are so many factors to be dealt with, many of which can not be foreseen, some of which are unpreventable, that not only are there no two vats alike, but it often occurs that the wine drawn from the same vat into different packages will develop quite differently. Unless the right course is pursued in the making and a correct fermentation is had, no really first-class wines can be made. These two factors are just as important to a really good wine as a proper foundation is to a good building, and it is equally true that good new wines as well as good new buildings can be soon made worthless by poor treatment and care. Then again, different types (and variations in these) of red and white, dry, sweet, and sparkling wines result from different varieties of grapes, differences of soil and climatic conditions, and variations in methods of manufacture. The grapes and wines of different years vary greatly. Long warm seasons with favorable ripening weather produce fine quality, whilst cool summers with an abundance of rain produce inferior quality.

It should also be noted that, while some varieties have all the requisites to produce an ideal wine, there are also varieties that contain too much of some elements and are deficient in others. Such, for instance, is the case with many of the American varieties, most notably the labruscas, which have too much of the foxy flavor and aroma and are often high in acid and deficient in sugar.

These are a few of the problems confronting the wine maker. It is therefore not surprising that poor wines are often made. A skilled wine maker might perhaps be compared to a fine cook in this, that the good cook, by doing this or that just so and just at the right time, prepares a meal which proves excellent, but which, prepared by a poor cook, would be unpalatable; similarly a good wine maker will make excellent wine from material out of which a poor wine maker will at the best make distilling material.

BRANDY.

It was not until the eighteenth century that brandy making became generally practiced in Europe. The brandies from white wines are better in quality than those from red wines, and, in some of the leading brandy districts, particular white-wine varieties are grown for brandy purposes, one of the favorite varieties being the Folle Blanche. One thousand gallons of wine yield from 100 to 180 gallons of proof brandy, depending, of course, on the sugar in the grapes or the alcoholic strength of the wine.

Practically all the grape brandy made in the United States for commercial purposes comes from California, where brandy making has for some years been quite a large and profitable industry. Large quantities are used in the manufacture of sweet wines, and the annual average output of commercial brandy in the State is in the neighborhood of 750,000 gallons.

VINEGAR.

The French word "vinaigre," from which the English word "vinegar" is derived, means sour wine. Two kinds of vinegar, white and red, made respectively from white and red wines, are produced. On account of the red color being undesirable for many purposes the white is usually preferred. "Sweet as sugar" and "sour as vinegar" are comparisons we often make. As opposite as those two qualities are, it is nevertheless true that the sourest substance is made from the sweetest.

The uses of vinegar in domestic economy, for medicinal purposes (in case of poisoning, sprains, etc.), and a number of other purposes, are familiar to all.

GRAPE SIRUP.

It is not very generally known that a very superior sirup is made from the grape, and that at one time quite a quantity was annually produced in this country. There is no reason why the manufacture of grape sirup could not be made a large and profitable industry. It has always been popular from the earliest ages down to the present day. Its manufacture demands close care and attention, but is otherwise exceedingly simple, and the machinery necessary is not at all expensive. In California it is now proposed to evaporate the juice of the grape to as near a solid substance as possible and to ship it thus, thereby

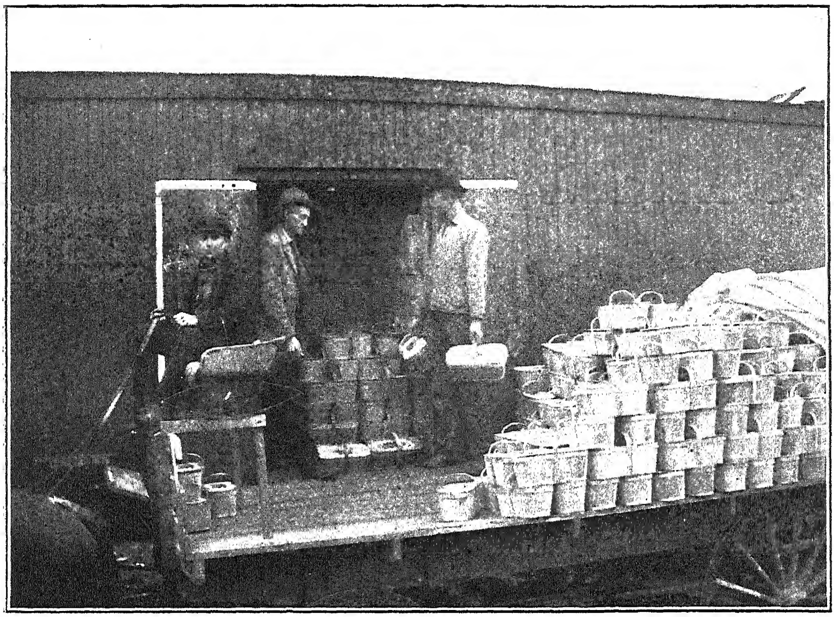


FIG. 1.—SHIPPING TABLE GRAPES IN NEW YORK STATE.

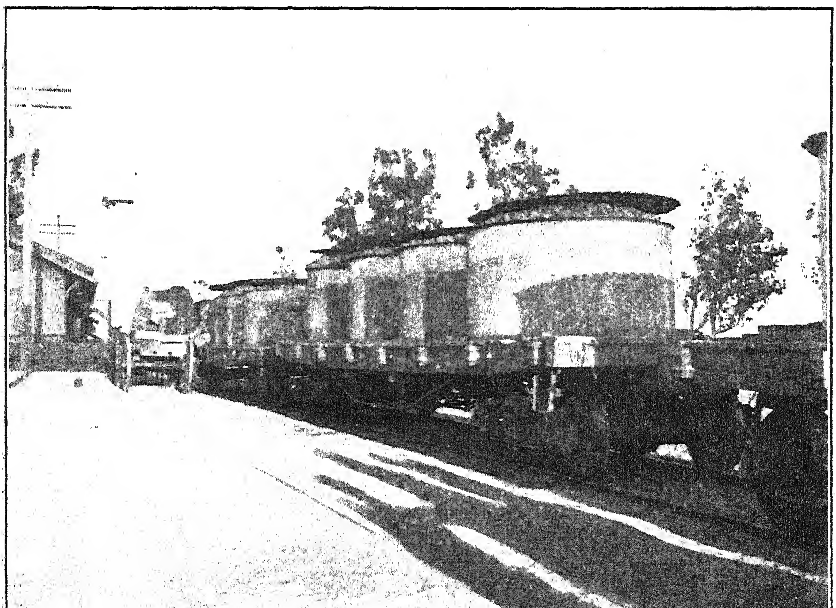


FIG. 2.—SHIPPING WINE GRAPES, CUCAMONGA, CAL.

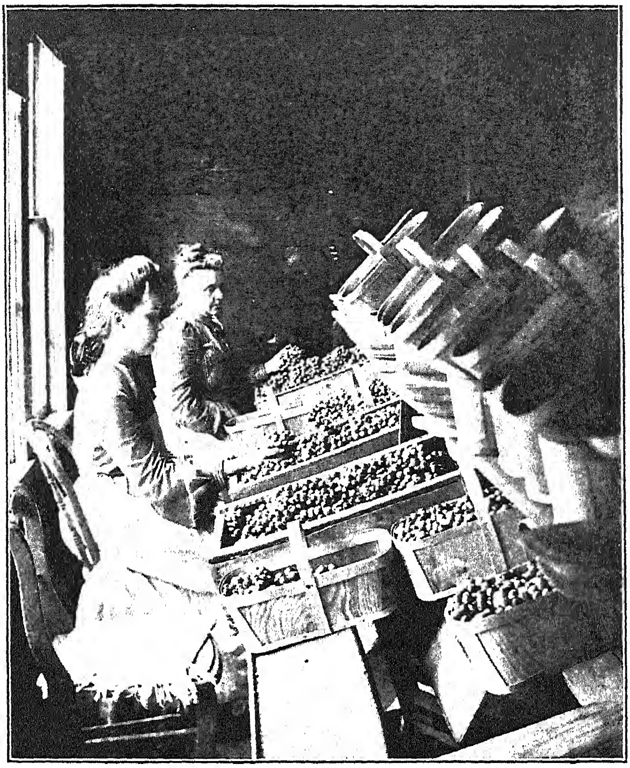


FIG. 1.—PACKING TABLE GRAPES IN NEW YORK STATE.

FIG. 2.—PACKING TABLE GRAPES IN CALIFORNIA.

reducing to a minimum the heavy cost of transporting it as a liquid in costly cooperage across the continent. After arriving at its destination it is to be brought back to the desired thinness by the addition of pure water, and made into grape juice, wine, or other products.

UNFERMENTED GRAPE JUICE.

The manufacture of unfermented grape juice has, especially in some of the States east of the Rocky Mountains, developed into an extensive and lucrative industry.[a] The unfermented grape juice manufacturing plants of the country turn out a product amounting to nearly 1,000,000 gallons annually; aside from this many housewives put up annual supplies of it. Through the medium of unfermented grape juice we can derive whatever benefit there may be in the grape cure everywhere and at all times of the year.

THE SHIPPING OF FRESH GRAPES.

The shipping of fresh grapes to market for table use is becoming more extensive every year, both as regards American varieties grown most largely in New York State and Vinifera or California-grown grapes. (Pl. XLVIII.) Many instances are on record in California where table grapes have given the producer a return of from $200 to as high as $350 an acre, and, as the packing is nearly all done by women, the work is so distributed (see Pl. XLIX) that entire families find lucrative, healthy, and pleasant employment. The statement has frequently been made to the writer by parties owning such vineyards that they are "about as good as a mint."

RAISINS.

Almost all the raisins grown in the United States are produced in California, where the production is practically confined to ten counties, with Fresno as the center of the industry. The history of the raisin industry furnishes one of the most interesting bits of fruit history in this country and was discussed by the writer in a former article.[b] (Pl. XLV, fig. 2.)

A FEW HOUSEHOLD RECIPES.

The products described in the foregoing paragraphs are the most important ones made from the grape for commercial purposes. The following are a few recipes for the use of the grape in household economy:

CANNED GRAPES.—Select fresh, firm, ripe berries, remove the stems, and can the same as other fruit. The fruit of seedless varieties, such

[a] For detailed information regarding its manufacture and preservation, and recipes for its use, see Bureau of Plant Industry Bulletin No. 24, or Farmers' Bulletin No. 175.

[b] Grape, Raisin, and Wine Production in the United States, Yearbook of the Department of Agriculture for 1902, pp. 407–420.

as the "Thompson seedless," is almost as good canned as when picked from the vine.

GRAPE PICKLES.—Take 7 pounds of ripe grapes and remove the stems; take 3 pounds of white sugar, 1 quart of cider vinegar, 1 ounce of cinnamon, and ½ ounce of cloves. Boil this and pour over the fruit for two mornings, and the third morning put fruit and all in preserving kettle; heat so as to simmer for a few minutes; then put it in glass or earthen jars, tie up securely, and keep in cool place.

GRAPE JELLY.—Select firm grapes not quite ripe, wash the berries well, pour into preserving kettle, and stew slowly for some minutes to free the juice. Strain through colander and then through jelly bag. Keep the juice as hot as possible. Measure the juice and add one pound of loaf sugar to each pint of juice. Boil fast (for at least thirty minutes) until done, and put in glasses.

SPICED GRAPES.—Take the pulp of the grapes, boil, and rub through a sieve so as to get rid of the seeds. Add the skins to the strained pulp and boil with sugar, vinegar, and spices, using for 7 pounds of grapes 4½ pounds of sugar and 1 pint of good vinegar. Spice quite highly with ground cloves, allspice, and a little cinnamon.

GRAPE MARMALADE.—Take 1 pound of grapes and 1 pound of sugar. Stew until well dissolved, put through strainer bowl and then through sieve. Cook until it becomes stiff as jam. Put away in small preserve jars.

GRAPE LEATHER.—Use same ingredients as for marmalade. Boil until quite stiff. Spread on marble slabs or china platters to dry.

GRAPE TRIFLE.—Pulp 2 pounds of ripe grapes through a sieve fine enough to extract the seeds. Add sugar to suit the taste. Put into a trifle dish, and cover with whipped cream nicely flavored. Serve cold.

GRAPE BUTTER.—This may be made of green or ripe grapes. If intended as a relish to serve with meats, the green grapes are to be preferred; or, if ripe grapes are used, a little sharp cider is added. Pick the grapes from the stems, wash well, and put into a granite kettle with just enough water to keep from burning. When soft enough, press them through a sieve to remove the seeds. To 7 pounds of grapes weighed before seeds are removed add a pint of sharp cider, and, if grapes are ripe, 2 ounces of cinnamon and one of cloves. Tie the spices up in muslin bags and remove when the butter is made. Allow 3½ pounds of sugar to 7 pounds of fruit, but do not add it until the butter is quite thick. Boil it until it is of the desired consistency. Some prefer adding lemon juice instead of cider or vinegar; from half to two-thirds of a cupful would make the given quantity of grapes quite sharp. A pint of clear grape juice added to the strained pulp makes the best butter of all.

Grape junket.—Take 2 quarts new milk; warm it on the stove to about blood heat; pour into a glass bowl; stir into it 2 tablespoonfuls of prepared rennet, 2 tablespoonfuls of powdered loaf sugar, ½ small wineglass of grape juice, and ½ wineglass of grape brandy. Let it stand until entirely cold, and serve with sugar and cream.

Grape pie.—Take the pulp from the grapes and heat a little to soften it; then rub through a sieve to get out the seeds. Add the skins. Sugar to taste, and bake.

BY-PRODUCTS.

The utilization of the wastes of the grape and the manufacture of by-products (fig. 42) from them has long been a profitable industry in

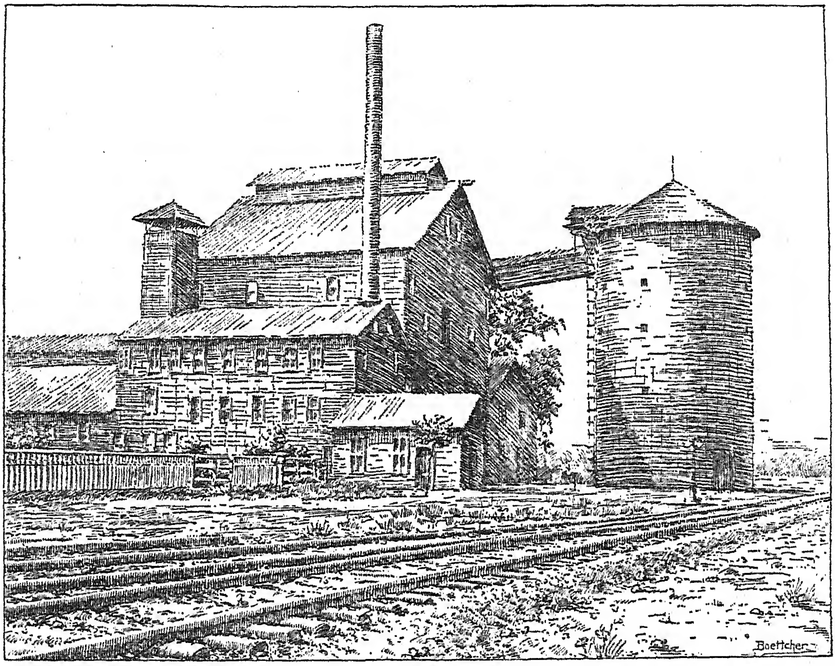


Fig. 42.—Grape by-product plant, Rutherford, Cal.

Europe. In this country only a start in this direction has been made. A few of the most important of these products will be mentioned.

PRODUCTS MADE FROM POMACE.

Pomace brandy.—After wine has been made from the grapes the pomace is often distilled and a product called pomace brandy made from it. In some cases water and sugar are added to the pomace, which is then refermented, and the resulting product is sold to the unknowing consumer as wine. The word wine as applied to this product is a misnomer.

Wash, or piquette.—This is also made from pomace, and is distilled and sold as brandy. To make wash, the pomace is put into fermenting vats, where it is sprinkled with water, which, after a certain length of time, is drawn off. This washes out part of the wine contained in the pomace. The same water is re-used on other pomace until it is high enough in alcoholic strength, when it is distilled.

The pomace, after wash has been made from it, contains the seeds, hulls, stems, etc., from which other valuable by-products may be made.

Feed and fertilizer.—Pomace from stemmed grapes makes excellent sheep and cattle feed when salted slightly and stored in silos. After the acids are neutralized in them, the pomaces are excellent manure, being rich in potash and nitrogen. Pomaces from unstemmed grapes are not so good.

Acetic acid.—The pomace may also be dried in vapor-tight rooms. In the process of drying, 50 to 60 per cent of the weight of the pomace becomes vapor, and this, condensed, yields acetic acid, of which it contains from 5 to 10 per cent.

PRODUCTS MADE FROM SKINS AND SEEDS.

After the pomace is dried, it is separated into stems, shells, and seeds. From the stems paper is made, and from the shells, or hulls, tartaric acid is extracted. A few of the uses to which the seeds are put are mentioned below.

Many vineyardists in Europe separate the seeds from the hulls on a sieve. This is easily accomplished if the pomace or marc is dry. The seeds are fed to horses, cattle, and poultry, the same as grain, and are said to be even better than oats. Ground up, they are used as a substitute for coffee. The seeds are crushed, and from them is obtained a high-grade oil, ranking next to olive oil and used for the same purposes. It is clear, yellow, and burns well without smoke or smell. A ton of grapes will yield from 40 to 100 pounds of seed, and about 3 quarts, or 16 pounds, of oil may be obtained from 100 pounds of seed. The product has the properties of a drying oil and can be used as a substitute for linseed oil. It also makes a superior soap, 100 pounds of oil making 166 pounds of soap.

Besides oil, the seeds yield tannin, which is used for tanning and other purposes. After these products have been taken out there remains a meal, which is an excellent general stock feed and a good fertilizer.

The manufacture of oil from grape seed is said to be an Italian invention, and has been practiced for about a century. In Italy the single Province of Verona manufactures yearly about 600,000 pounds of oil. It is claimed that the seeds in California-grown grapes are larger in size and number than those of grapes grown in Europe.

In California the seeds coming from the raisin seeding and packing establishments are washed in order to rid them of the pulp adhering to them. This pulp is fermented and distilled, the product being marketed as brandy. The seeds, besides being used for purposes before mentioned, are useful in treating wines for sliminess. There is one by-product establishment in California which receives several thousand tons of waste of this nature annually.

THE LEES OF WINE.

Lees are the sediment that settles in the casks in which the new wine is stored. These are especially valuable on account of the cream of tartar and calcium tartrate they contain, from which tartaric acid can be extracted. These elements vary from 20 to 70 per cent of the lees, according to the way in which the wine has been handled. In the lees some alcohol is also retained mechanically. The lees can be distilled or pressed to extract the wine they contain, and they are then dried and sold to cream of tartar works.

Grape juice owes its sourness almost entirely to acid tartrates of potash. While the juice ferments, the greater part of the acid tartrate separates out along with tartrate of lime, coloring matters, and other impurities as a hard crust adhering to the sides of the cask. Such impure acid tartrate of potash is known commercially as argol. Red wines are usually richer in argol than white wines, and give a red color to the crude article. A ton of grapes yields, according to the composition and treatment of the fruit, quantities varying between 1 and 2 pounds of argol. The tartaric acid of commerce is prepared from tartar or argol, and was first separated from it by Scheele in 1769. It is used in baking powders, effervescing drinks, as medicine, in calico printing, etc. The United States at present imports from France, Italy, and Germany about $3,000,000 worth annually. The American Grape Acid Association, of San Francisco, about one and one-half years ago offered a reward of $25,000 for the best and most practical formula and process for making cream of tartar from grapes. About 375 formulas have been submitted. These have been sent in from all over the world. The jury are now going over the proposals presented to them. It is expected that their conclusions will be announced in the near future.

VALUE OF THE WASTES OF THE GRAPE CROP.

It is safe to assume that if all the wastes of the grape crop were utilized the extra returns would increase the value of the crop fully 10 per cent. California has a wine producing area equal to almost the whole of France. As California's present production is to that of France about as 1 is to 35, the very great economic importance of proper utilization of these by-products becomes apparent.

It is estimated that the by-products of the present grape production of Fresno County, Cal., if utilized would be worth $500,000 annually. For this country, with its present production of grapes, wines, raisins, etc., to the value of about $15,000,000, this would mean an additional earning of about $1,500,000, and this with the viticultural industry as yet in its infancy.

INSECT INJURIES TO FOREST PRODUCTS.

By A. D. Hopkins,
In Charge of Forest Insect Investigations, Bureau of Entomology.

CHARACTER AND EXTENT OF INJURY.

The detrimental and destructive work of insects which cause serious losses in commercial woods, barks, nuts, etc., consists of burrows or galleries excavated by the young and matured forms of beetles and a few other kinds of insects.

Round timber, rough lumber, and other crude products are seriously injured by pinhole and wormhole defects caused by a class of wood-boring beetles and grubs.

Seasoned rough and dressed lumber and finished wood material is damaged or completely destroyed by a class of so-called powder post borers, which convert the woody tissue into a mass of fine dust or powder.

Construction timbers and other wood material utilized in buildings, bridges, railroad construction, mining, etc., are often infested by wood-boring grubs, powder post borers, white ants, and other insects, to their serious detriment or destruction.

Stored oak and hemlock bark for tanning purposes is, under certain conditions, seriously damaged or destroyed by insects which infest the inner or "flesh" parts and convert them into a fine powder.

Medicinal barks, roots, and leaves are also bored or eaten by drug beetles, causing injuries which, while not necessarily destroying the medicinal qualities, are detrimental to the commercial value of such material.

From the writer's personal investigations of this subject in different sections of the country, the damage to forest products of various kinds from this cause seems to be far more extensive than is generally recognized. Allowing a loss of 5 per cent on the total value of the forest products of the country, which the writer believes to be a conservative estimate, it would amount to something over $30,000,000 annually. This loss differs from that resulting from insect damage to natural forest resources in that it represents more directly a loss of money invested in material and labor.

KNOWLEDGE NECESSARY TO PREVENTION OF LOSSES.

In dealing with the insects mentioned, as with forest insects in general, the methods which yield the best results are those which relate directly to preventing attack. In order to meet with the best success, however, it is necessary to have a complete knowledge of the insects which cause the injuries and the conditions which are attractive to them or otherwise favor their attack, as well as those which are unattractive or unfavorable.

The insects have two objects in their attack; one is to obtain food, the other is to prepare for the development of their broods. Different species of insects have special periods during the season of activity (March to November) when the adults are on the wing in search of suitable material in which to deposit their eggs. Some species which fly in April will be attracted to the trunks of recently felled pine trees or to piles of pine sawlogs from trees felled the previous winter. They are not attracted to any other kind of timber, because they can live only in the bark or wood of pine, and only in that which is in the proper condition to favor the hatching of their eggs and the normal development of their young. As they fly only in April, they can not injure the logs of trees felled during the remainder of the year. There are also oak insects, which attack nothing but oak; hickory insects, cypress insects, spruce insects, and so on, which have different habits and different periods of flight and require special conditions of the bark and wood for depositing their eggs or for the subsequent development of their broods. Some of these insects have but one generation in a year, others have two or more, while some require more than one year for their complete development and transformation. Some species deposit their eggs in the bark or wood of trees soon after they are felled or before any perceptible change from the normal living tissue has taken place; other species are attracted only to dead bark and dead wood of trees which have been felled or girdled for several months; others are attracted to dry and seasoned wood; while another class will attack nothing but very old dry bark or wood of special kinds and under special conditions. Thus, it will be seen how important it is for the practical man to have a knowledge of such of the foregoing facts as apply to his immediate interest in the manufacture or utilization of a given forest product, in order that he may, with the least trouble and expense, adjust his business methods to meet the requirements for preventing losses.

DISTINCTIVE CHARACTER OF INSECT INJURIES.

The work of different kinds of insects, as represented by special injuries to forest products, is the first thing to attract attention, and the distinctive character of this work is easily observed, while the insect

responsible for it is seldom seen, or it is so difficult to determine by the general observer, from descriptions or illustrations, that the species is rarely recognized. Fortunately, the character of the work is often sufficient in itself to identify the cause and suggest a remedy, and, in this paper, primary consideration is given to this phase of the subject.

AMBROSIA OR TIMBER BEETLES.

The characteristic work of this class of wood-boring beetles is shown in figures 43, 44, and 45. The injury consists of pinhole and stained-wood defects in the sapwood and heartwood of recently felled or girdled trees, sawlogs, pulpwood, stave and shingle bolts, green or

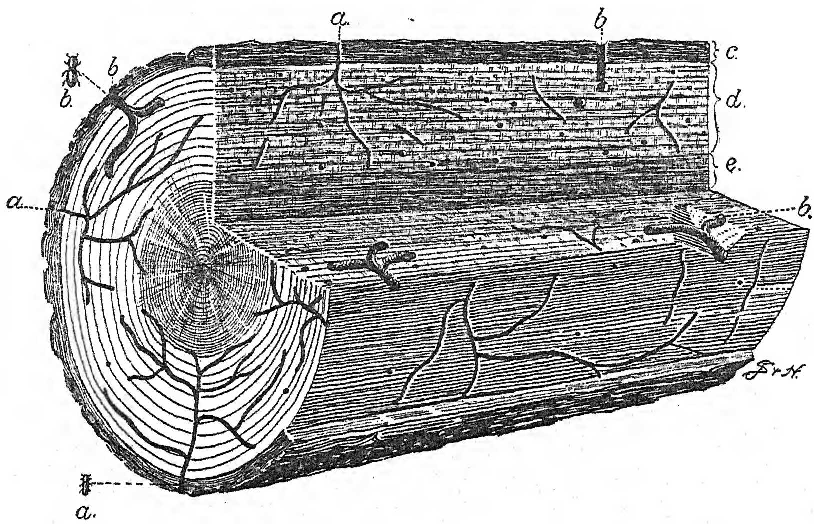


FIG. 43.—Work of ambrosia beetles in tulip or yellow poplar wood: *a*, work of *Xyleborus affinis* and *Xyleborus inermis*; *b*, *Xyleborus obesus* and work; *c*, bark; *d*, sapwood; *e*, heartwood. (Original.)

unseasoned lumber, and staves and heads of barrels containing alcoholic liquids. The holes and galleries are made by the adult parent beetles to serve as entrances and temporary homes or nurseries for the development of their broods of young, which feed on a kind of fungus growing on the walls of the galleries. The growth of this ambrosia-like fungus is induced and controlled by the parent beetles, and the young are dependent upon it for food. The wood must be in exactly the proper condition for the growth of the fungus in order to attract the beetles and induce them to excavate their galleries; it must have a certain degree of moisture and other favorable qualities which usually prevail during the period involved in the change from living, or normal, to dead or dry wood; such a condition is found in recently felled trees, sawlogs, or like crude products.

There are two general types or classes of these galleries—one in

which the broods develop together in the main burrows (figs. 43 and 44), the other in which the individuals develop in short separate side

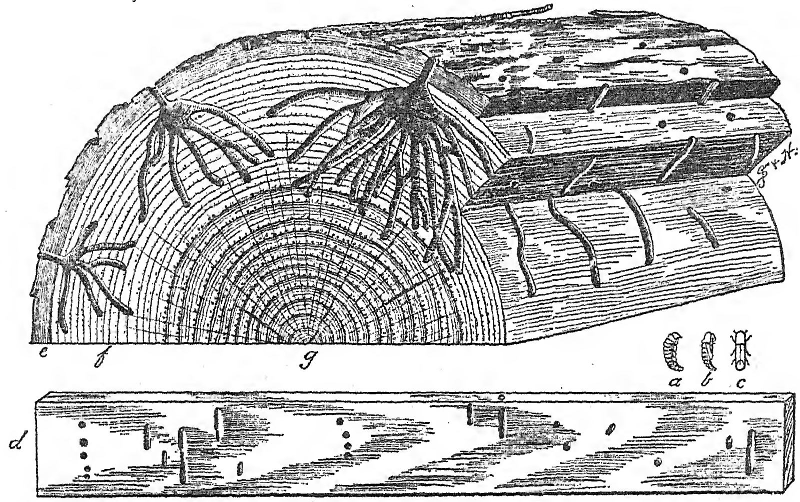


FIG. 44.—Work of ambrosia beetle, *Xyleborus celsus*, in hickory wood: *a*, larva, *b*, pupa; *c*, adult beetle, natural size; *d*, character of work in lumber cut from injured log; *e*, bark; *f*, sapwood; *g*, heartwood. (Original.)

chambers extending at right angles from the primary gallery (fig. 45). The galleries of the latter type are usually accompanied by a distinct staining of the wood, while those of the former are not.

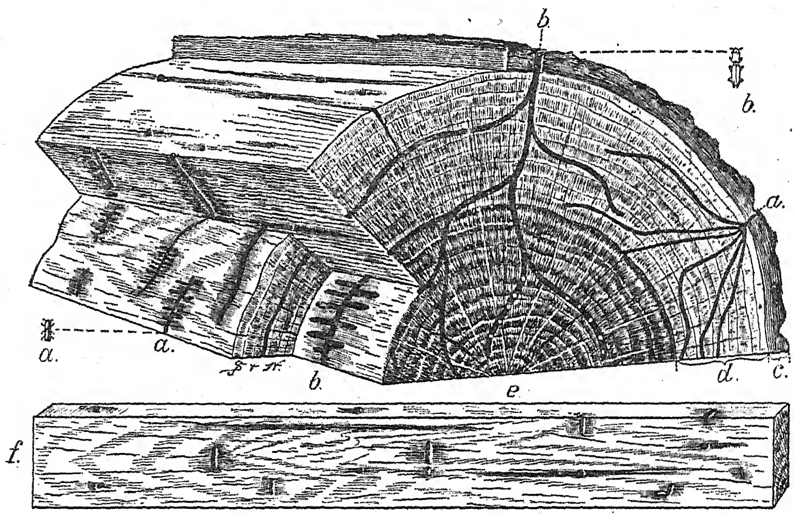


FIG. 45.—Work of ambrosia beetles in oak: *a*, *Monarthrum mali* and work; *b*, *Platypus compositus* and work; *c*, bark; *d*, sapwood; *e*, heartwood; *f*, character of work in lumber from injured log. (Original.)

The beetles responsible for this work are cylindrical in form, apparently with a head (the prothorax) half as long as the remainder of the

body (figs. 43, *a*, and 45, *a*). North American species vary in size from less than one-tenth to slightly more than two-tenths of an inch, while some of the subtropical and tropical species attain a much larger size. The diameter of the holes made by each species corresponds closely to that of the body, and varies from about one-twentieth to one-sixteenth of an inch for North American, and to one-eighth of an inch for the tropical species.

ROUND-HEADED BORERS.

The character of the work of this class of wood and bark-boring grubs is shown in figure 46. The injuries consist of irregular flattened or nearly round wormhole defects in the wood which sometimes result in the destruction of the valuable parts of wood or bark material.

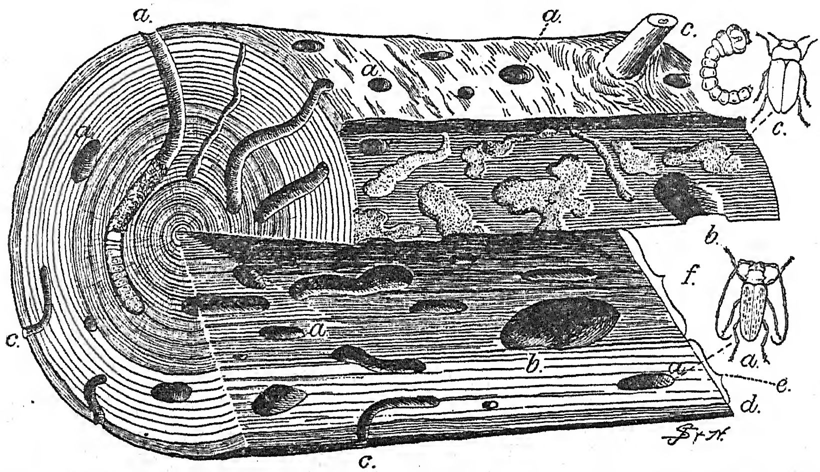


FIG. 46.—Work of round-headed and flat-headed borers in pine: *a*, work of round-headed borer, "sawyer," *Monohammus* sp., natural size; *b*, *Ergates spiculatus*; *c*, work of flat-headed borer, *Buprestis*, larva and adult; *d*, bark; *e*, sapwood; *f*, heartwood. (Original.)

The sapwood and heartwood of recently felled trees, sawlogs, poles, posts, mine props, pulpwood, and cordwood, also lumber or square timber with bark on the edges, and construction timber in new and old buildings, are injured by wormhole defects, while the valuable parts of stored oak and hemlock tanbark and certain kinds of wood are converted into worm dust. These injuries are caused by the young or larvæ of long-horned beetles. Those which infest the wood hatch from eggs deposited in the outer bark of logs and like material, and the minute grubs hatching therefrom bore into the inner bark, through which they extend their irregular burrows for the purpose of obtaining food from the sap and other nutritive material found in the plant tissue. They continue to extend and enlarge their burrows as they increase in size, until they are nearly or quite full grown. They then enter the wood and continue their excavations deep into the sapwood

or heartwood until they attain their normal size. They then excavate pupa cells in which to transform into adults, which emerge from the wood through exit holes in the surface.

This class of borers is represented by a large number of species. The adults, however, are seldom seen by the general observer unless cut out of the wood before they have emerged. Many of them fly at night, while others are so nearly the color of the bark on which they rest that they are difficult to find. The holes made by these borers vary in size from very minute to more than an inch in diameter, but the intermediate sizes are most common.

FLAT-HEADED BORERS.

The work of flat-headed borers is only distinguished from that of the preceding by the broad, shallow burrows and the much more oblong form of the exit holes. In general, the injuries are similar and affect the same class of products, but they are of much less importance. The adult forms are flattened, metallic-colored beetles, and represent many species, of various sizes.

TIMBER WORMS.

The character of the work done by the borers of this class is shown in figure 47. The injury consists of pinhole defects in the sapwood and heartwood of felled trees, sawlogs, and like material which have

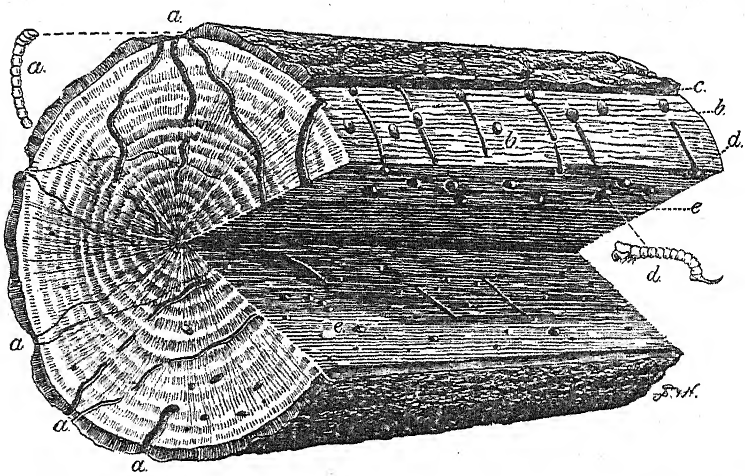


FIG. 47.—Work of timber worms in oak: *a*, work of oak timber worm, *Eupsalis minuta*; *b*, barked surface; *c*, bark; *d*, sapwood timber worm, *Hylocœtus lugubris*, and work; *e*, sapwood. (Original.)

been left in the woods or in piles in the open for several months during the warmer seasons. Stave and shingle bolts and closely piled oak lumber and square timbers also suffer from injury of this kind. These

injuries are made by elongate, slender worms or larvæ which hatch from eggs deposited by the adult beetles in the outer bark, or, where there is no bark, just beneath the surface of the wood. At first the young larvæ bore almost invisible holes for a long distance through the sapwood and heartwood, but as they increase in size the same holes are enlarged and extended until the larvæ have attained their full growth. They then transform to adults and emerge through the enlarged entrance burrows. The work of these timber worms is distinguished from that of the timber beetles by the greater variation in the size of holes in the same piece of wood; also by the fact that they are not branched from a single entrance or gallery, as are those made by the beetles.

POWDER POST BORERS.

The character of work of this class of insects is shown in figures 48, 49, 50, and 51. The injury consists of closely placed burrows packed with the borings or a completely destroyed or powdered condition of

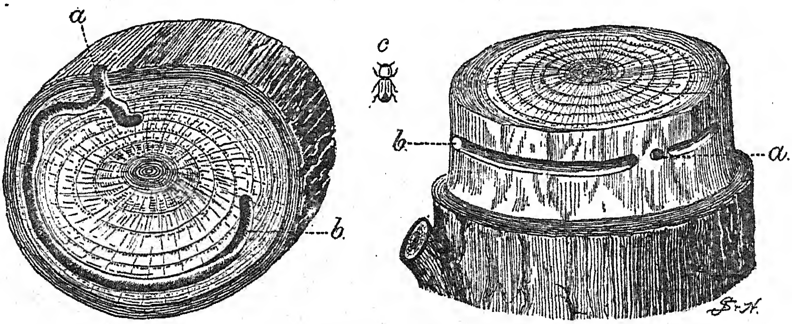


FIG. 48.—Work of powder post beetle, *Sinoxylon basilare*, in hickory poles, showing transverse egg galleries excavated by the adult: *a*, entrance; *b*, gallery; *c*, adult. Natural size (original).

the wood of seasoned products, such as lumber, crude and finished handle, cooperage, and wagon stock, furniture, and inside finish wood-

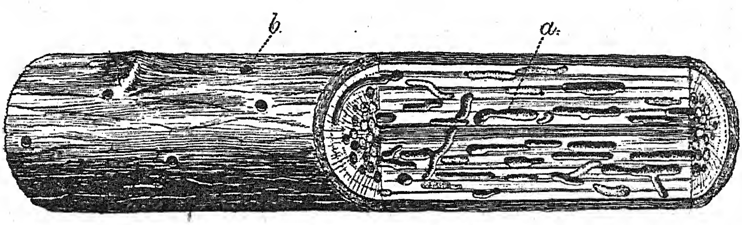


FIG. 49.—Work of powder post beetle, *Sinoxylon basilare*, in hickory pole: *a*, character of work by larvæ; *b*, exit holes made by emerging broods. (Original.)

work in old buildings, as well as in many other crude or finished and utilized woods. This is the work of both the adults and young stages

of some species, or of the larval stage alone of others. In the former, the adult beetles deposit their eggs in burrows or galleries excavated for the purpose, as in figures 48 and 49, while in the latter (figs. 50 and 51) the eggs are deposited on or beneath the surface of the wood. The grubs complete the destruction by boring through the solid wood in all directions and packing their burrows with the powdered wood. When they are full grown they transform to the adult and emerge from the injured material through round holes in the surface. Some of the species continue to work in the same wood until many generations have developed and emerged, or until every particle of wood tissue has been destroyed and the available nutritive substance extracted.

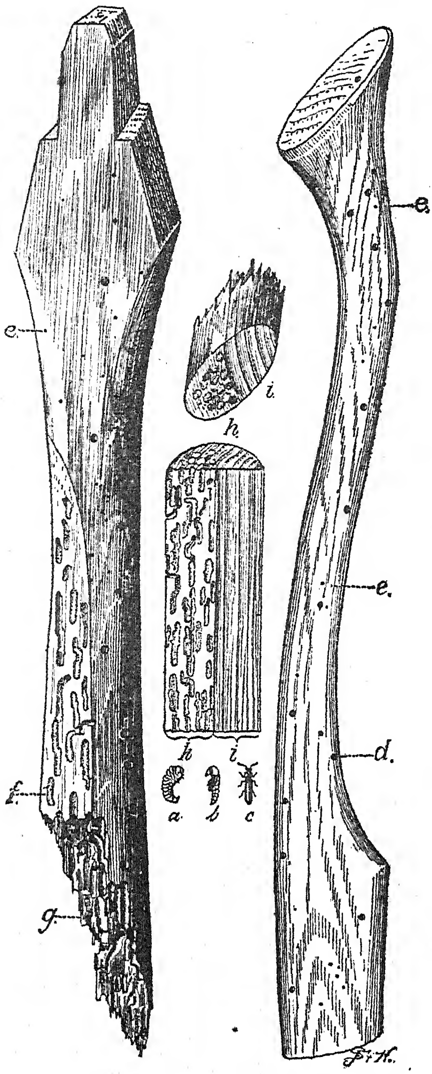


FIG. 50.—Work of powder post beetle, *Lyctus striatus*, in hickory handles and spokes: *a*, larva; *b*, pupa; *c*, adult, natural size; *d*, exit holes; *e*, entrance of larvæ (vents for borings are exits of parasites); *f*, work of larvæ; *g*, wood, completely destroyed; *h*, sapwood; *i*, heartwood. (Original.)

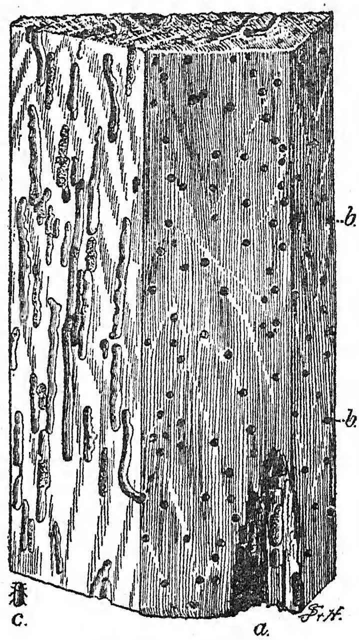


FIG. 51.—Work of powder post beetle, *Xyletinus peltatus*, in old pine flooring: *a*, work of larvæ; *b*, exit holes made by emerging broods; *c*, adult, natural size. (Original.)

WHITE ANTS, OR TERMITES.

The character of the work of white ants, or termites, in wood is shown in figure 52. It consists of burrows, galleries, and tunnels of greatly varying sizes, and of every conceivable shape, extended in all directions through the wood. A peculiar character is the complete destruction of the inner portion of the wood, while slight or no evidence is shown on the exposed surface. In this work these insects employ a kind of earthy matter mixed with macerated wood to cover or roof in such parts of the galleries as would otherwise be exposed to the light; also to cover their paths over the surface of stone, iron, or uninjured wood, where inside tunnels are not made, to protect them from light and from their enemies as they travel from place to place to visit or extend their burrows and nests.

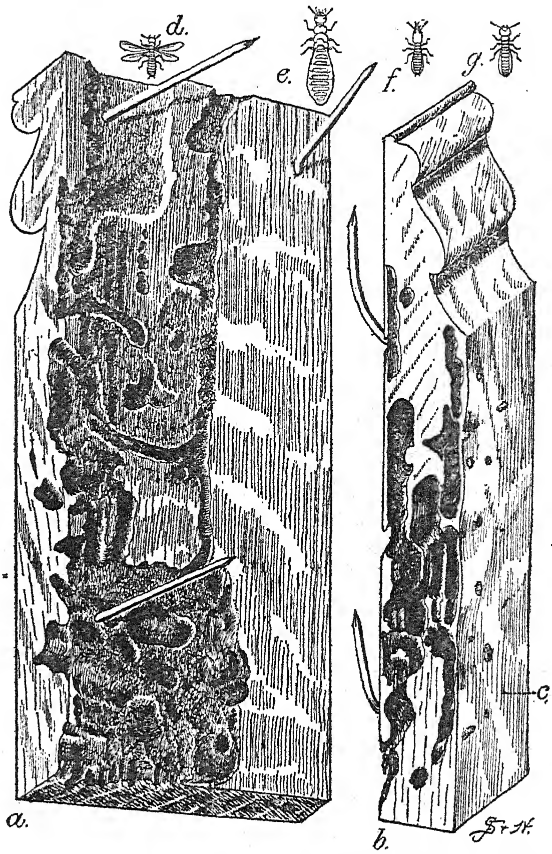


FIG. 52.—Work of white ant, or termite, *Termes flavipes*, in sound and dry red oak molding from door casing: *a*, inner portion; *b*, longitudinal section; *c*, outer surface; *d*, male; *e*, female; *f*, soldier; *g*, worker, natural size. (Original.)

The injuries to forest products, both crude and finished, consist of a partial or complete destruction of the infested material. Under certain conditions greater damage and loss is caused than by the work of any other class of insects. A great variety of products is affected, such as round and square timbers left for some time next to the ground, posts and poles set in the ground, railroad ties, bridge timbers, and lumber in the bottom of stacks; and these insects are especially destructive to the underpinning, flooring, and all other wooden parts of buildings which are readily accessible to the little destroyers. The excavations are made by the insects for the purpose of obtaining food and to serve as habitations and nurseries for the great number of individuals which occupy them.

These insects are not true ants, but resemble them somewhat in size and general appearance. They correspond in their social habits to ants and bees in that each colony includes workers, soldiers, males and females (winged or wingless), and a single royal pair.[a]

BLACK ANTS.

The work of the true ants in wood somewhat resembles that of white ants, and is done for the same or similar purposes and under similar conditions, but is much less common or injurious. It usually consists in the extension of the work or damage started by other wood-boring insects, through the galleries of which the black ant gains entrance to the inner wood, which is sometimes honeycombed.

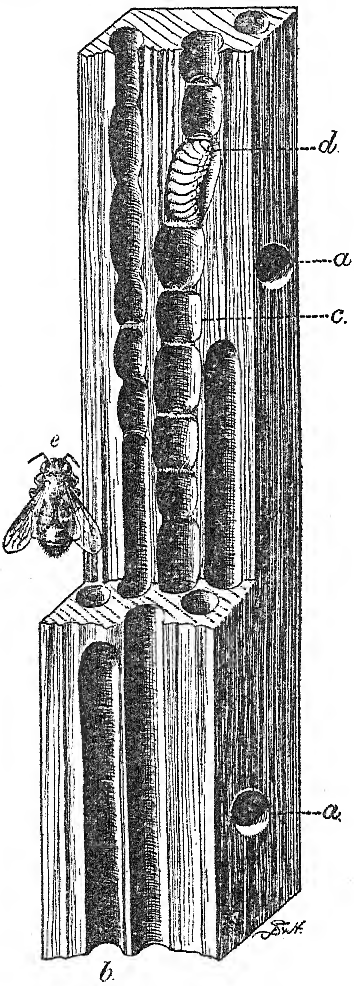


FIG. 53.—Work of carpenter bee, *Xylocopa orpifex*, in redwood lumber from San Jose, Cal.: *a*, entrance; *b*, galleries; *c*, cells; *d*, larva; *e*, adult—slightly reduced. (Original.)

CARPENTER BEES.

The work of this class of wood-boring bees is shown in figure 53. The injury consists of large augerhole-like tunnels in exposed solid dry wood of buildings and other structures. It is most common in soft woods, such as pine, poplar, redwood, and the like, the latter being especially liable to attack in California and the Southwest.

NUT WEEVILS AND THEIR ALLIES.

The characteristic work of this class of insects is a mined or mealy condition of the kernel or inner parts, the surface being pierced by round holes and otherwise injured or destroyed. The loss results from the worthless condition of the infested material as an article of commerce, as food, and for planting, whether naturally or artificially.

Many kinds of insects are responsible for injuries of this kind, such as weevils and other beetles, caterpillars of moths, and gall flies. In most cases where the inner portion of nuts or seeds is injured by weevils, the

[a] For further information on these insects, see article by C. L. Marlatt, in Bulletin No. 4, new series, of the Bureau of Entomology.

eggs are deposited in the young pods, so that the entrance burrows made by the minute young larvæ are completely hidden before the nuts are matured. After the larvæ in nuts complete their growth they bore their way out and enter the ground to pass the winter, and transform to the adult the next season. In certain kinds of seeds the transformation to the adult takes place within.[a]

DRUG BEETLES.

Injury by this class of enemies to certain medicinal products of the forest consists of the honeycombed, sieve-like, or powdered condition of certain kinds of barks, roots, stems, leaves, and seeds. The insects responsible for the work belong to the class of true powder post borers, and have similar habits.

CONDITIONS FAVORABLE FOR INSECT INJURY.

CRUDE PRODUCTS.

Round timber with bark on.—Newly felled trees, sawlogs, telegraph poles, posts, and like material, cut in the fall and winter and left on the ground or in close piles during a few weeks or months in the spring and summer, are especially liable to injury by ambrosia beetles (figs. 43, 44, and 45), round and flat-headed borers (fig. 46), and timber worms (fig. 47), as are also trees felled in the warm season and left for a time before working up into lumber. The proper degree of moisture found in freshly cut living or dying wood, and the period when the insects are flying, are the conditions most favorable for attack. This period of danger varies with the time of the year the timber is felled and with different kinds of trees. Those felled in late fall and winter will generally remain attractive to ambrosia beetles and the adults of round and flat-headed borers during March, April, and May. Those felled in April to September may be attacked in a few days after they are felled, and the period of danger may not extend over more than a few weeks. Certain kinds of trees felled during certain months and seasons are never attacked, because the danger period prevails only when the insects are flying; on the other hand, if the same kinds of trees are felled at a different time, the conditions may be most attractive when the insects are active, and they will be thickly infested and ruined.

The presence of bark is absolutely necessary for infestation by most of the wood-boring grubs, since the eggs and young stages must occupy the outer and inner portions before they can enter the wood. Some ambrosia beetles and timber worms will, however, attack barked logs, especially those in close piles and otherwise shaded and protected from rapid drying. The sapwood of pine, spruce, fir, cedar,

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[a] For further information on these insects, see article by F. H. Chittenden, Bulletin No. 44, Bureau of Entomology, pp. 24–43.

cypress, and like soft wood is especially liable to injury by ambrosia beetles, while the heartwood is sometimes ruined by a class of round-headed borers known as sawyers. Yellow poplar, oak, chestnut, gum,

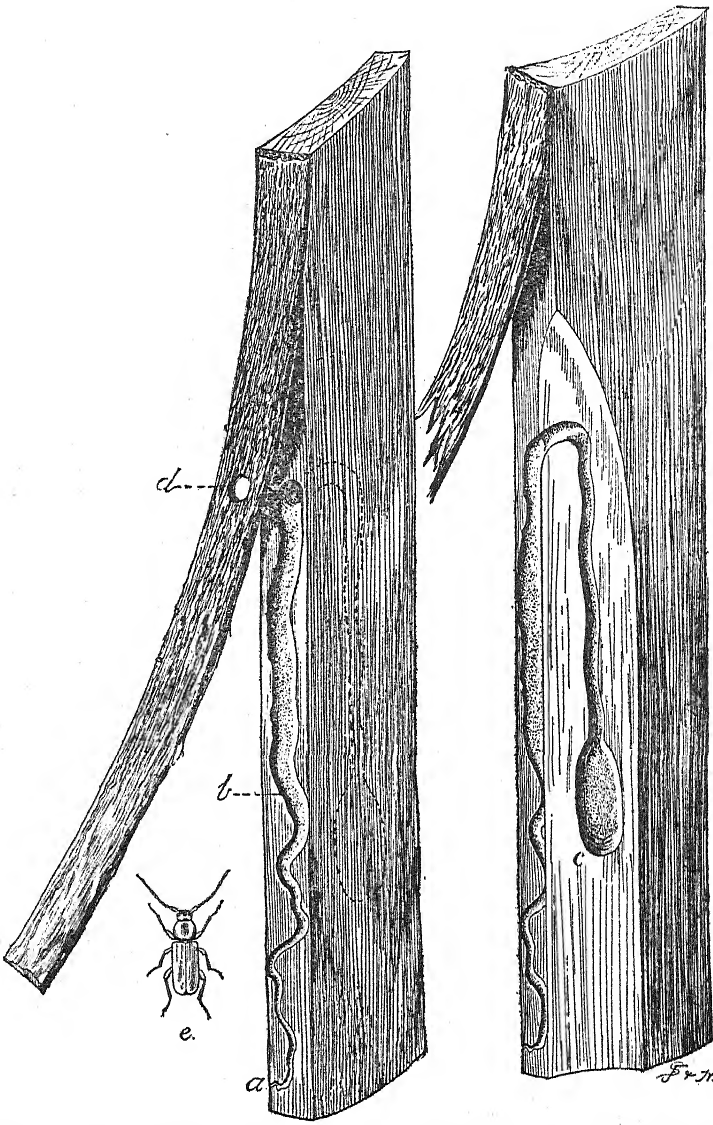


FIG. 54.—Work of round-headed borer, *Callidium antennatum*, in white pine bucket staves from New Hampshire: *a*, where egg was deposited in bark; *b*, larval mine; *c*, pupal cell; *d*, exit in bark; *e*, adult, slightly reduced. (Original.)

hickory, and most other hardwoods, are, as a rule, attacked by species of ambrosia beetles, sawyers, and timber worms different from those infesting the pines, there being but very few species which attack both.

Mahogany and other rare and valuable woods imported from the

Tropics to this country in the form of round logs, with or without the bark on, are commonly damaged, more or less seriously, by ambrosia beetles and timber worms. It would appear, from the writer's investigations of logs as received at the mills in this country, that the principal damage is done during a limited period from the time the trees are felled until they are placed in the fresh or salt water for transportation to the shipping points. If, however, the logs are loaded on the vessel direct from the shore, or if not left in the water long enough to kill the insects, the latter will continue their destructive work during transportation to this country and after they arrive until cold weather ensues or the logs are converted into lumber. It was also found that a thorough soaking in sea water, while it usually killed the insects at the time, did not prevent subsequent attack by both foreign and native ambrosia beetles; also, that the removal of the bark from such logs previous to their immersion did not render them entirely immune. Indeed, it was found that those with the bark off were attacked more than those with it on, owing, doubtless, to the greater amount of saline moisture absorbed and retained by the bark.

From the foregoing it will be seen that some requisites for preventing insect injuries to round timber are:

(1) To provide for as little delay as possible between the felling of the tree and its manufacture into rough products. This is especially necessary with trees felled from April to September in the region north of the Gulf States, and from March to November in the latter, while the late fall and winter cutting should all be worked up by March or April.

(2) If the round timber must be left in the woods or on the skidways during the danger period, every precaution should be taken to facilitate rapid drying of the inner bark, by keeping the logs off the ground, in the sun, or in loose piles; or else the opposite extreme should be adopted, and the logs kept in water.

(3) The immediate removal of all of the bark from poles, posts, and other material which will not be seriously damaged by checking or season cracks.

(4) To determine and utilize the proper months or seasons to girdle or fell different kinds of trees. Bald cypress in the swamps of the South are girdled in order that they may die and in a few weeks or months dry out and become light enough to float. This method has been extensively adopted in sections where it is the only practicable one by which the timber can be transported to the sawmills. It is found, however, that some of these girdled trees are especially attractive to several species of ambrosia beetles (figs. 43, 44, and 45), round-headed borers (fig. 46), and timber worms (fig. 47), which cause serious injury to the sapwood or heartwood, while other trees girdled at a different

time or season are not injured. This suggested to the writer the importance of experiments to determine the proper time to girdle trees to avoid losses, and they are now being conducted on an extensive scale, in cooperation with prominent cypress operators in different sections of the cypress-growing region.

SAPLINGS.—Saplings, including hickory and other round hoop poles and similar products, are subject to serious injuries and destruction by round and flat-headed borers (fig. 46) and certain species of powder post borers (figs. 48 and 49) before the bark and wood are dead or dry, and also by other powder post borers (fig. 50), after they are dried and seasoned. The conditions favoring attack by the former class are those resulting from leaving the poles in piles or bundles in or near the forest for a few weeks during the season of insect activity, and by the latter, from leaving them stored in one place for several months.

STAVE AND SHINGLE BOLTS.—These are attacked by ambrosia beetles (figs. 43–45) and the oak timber worm (fig. 47, *a*), which, as has been frequently reported, cause serious losses. The conditions favoring attack by these insects are similar to those mentioned under "Round timber." The insects may enter the wood before the bolts are cut from the log, or afterwards, especially if the bolts are left in moist, shady places in the woods in close piles during the danger period. If cut during the warm season, the bark should be removed and the bolts converted into the smallest practicable size and piled in such a manner as to facilitate rapid drying.

HANDLE AND WAGON STOCK IN THE ROUGH.—The crude material from which this class of products is manufactured is especially liable to injury by ambrosia beetles and round-headed borers, and, during the warmer seasons, special precaution is required to prevent damage. The conditions favoring attack of the round logs and bolts are the same as with other round timber. Hickory and ash in the round with the bark on are almost certain to be greatly damaged if the winter and spring cuttings are held over a few weeks after the middle of March or first of April.

PULPWOOD AND CORDWOOD.—Pulpwood is injured by ambrosia beetles and round-headed borers, and cordwood by the latter. The conditions favoring attack are those resulting from close piling, and leaving in the woods, or in shady damp places, from a few weeks after the first of April to the first of August. Material of this kind is sometimes riddled with holes, or converted into "sawdust," if left in close piles for a few months during the summer. This damage can be avoided, to a great extent, by placing the sticks of wood in triangular, or crib, piles immediately after they are cut from the tree—a common practice in the South. This facilitates rapid drying and renders the

wood immune. Peeling and splitting of the wood before it is piled is also desirable for the same purpose.

UNSEASONED PRODUCTS IN THE ROUGH.

Freshly sawed hardwood lumber placed in close piles during warm, damp weather in July and September presents especially favorable conditions for injury by ambrosia beetles (figs. 43, *a*, and 45, *a*.) This is due to the continued moist condition of such material. Heavy 2-inch or 3-inch stuff is also liable to attack even in loose piles with lumber sticks. An example of the latter was found in a valuable lot of mahogany lumber of first grade, the value of which was reduced two-thirds by injury from a native ambrosia beetle. Numerous complaints have been received from different sections of the country of this class of injury to oak, poplar, gum, and other hardwoods. In all cases it is the moist condition and retarded drying of the lumber which induces attack; therefore any method which will provide for the rapid drying of the lumber, before or after piling, will tend to prevent losses. It is important that heavy lumber should, as far as possible, be cut in the winter and piled so that it will be well dried out before the middle of March.

Lumber and square timber with the bark on the edges or sides often suffer from injuries by flat and round-headed borers hatching from eggs deposited in the bark of the logs before they are sawed or after the lumber has been sawed and piled. One example of serious damage and loss was reported in which white pine staves for paint buckets and other small wooden vessels, which had been sawed from small logs and the bark left on the edges, were attacked by a round-headed borer, the adults having deposited their eggs in the bark after the stock was sawed and piled. The character of the injury is shown in figure 54, page 392.

Another example was reported from a manufacturer in the South, where the pieces of lumber which had a strip of bark on one side were seriously damaged by the same kind of borer, the eggs having been deposited in the logs before sawing or in the bark after the lumber was piled. If the eggs are deposited in the logs and the borers have entered the inner bark, or the wood, before sawing, they may continue their work regardless of methods of piling; but if such lumber is cut from new logs and placed in the pile while green, with the bark surface up, it will be much less liable to attack than if piled with the bark down. This liability of lumber, with bark edges or sides, to be attacked by insects suggests the importance of the removal of the bark to prevent damage, or, if this is not practicable, the lumber with the bark on the sides should be piled in open, loose piles with the bark up, while that with the bark on the edges should be placed on the outer edges of the pile, exposed to the light and air.

A moist condition of lumber and square timber, such as results from close or solid piles with the bottom layers on the ground, or on a foundation of old decaying logs, or near decaying stumps and logs, offers especially favorable conditions for the attack of white ants.

SEASONED PRODUCTS IN THE ROUGH.

DRY LUMBER.—Dry lumber in stacks or storage is liable to injury by powder post borers (fig. 50). The conditions favoring attack are: (1) The presence of a large proportion of sapwood, as in hickory, ash, and similar woods; (2) material which is two or more years old or that which has been kept in one place for a long time; (3) access to old infested material. Therefore such lumber should be frequently examined for evidence of the presence of these insects. This is always indicated by fine flour-like powder on or beneath the piles, or otherwise associated with such material. All infested material should be at once removed and the infested parts destroyed by burning.

DRY COOPERAGE, WAGON, AND HANDLE STOCK.—These are especially liable to attack and serious injury by powder post borers (fig. 50), under the same or similar conditions as in the case of dry lumber.

FINISHED OR UTILIZED PRODUCTS.

TIMBERS AND OTHER WOODWORK IN NEW AND OLD BUILDINGS.—These are often injured by powder post borers (fig. 50), or white ants (fig. 52). If by the former in new structures, it indicates that infested material was used in the structure and that after being thus introduced the insects continued to breed and extend the injuries, regardless of paint and varnish or other external treatment which would otherwise prevent attack. If the trouble occurs in old buildings it is usually due to a large proportion of sapwood in the frame timbers, flooring, and other parts, which, owing to the age of such material, is rendered especially attractive to certain classes of powder post borers. After such wood is once infested, the insects continue to breed and extend their work for many years, or until all the sapwood is converted into powder. Figure 51 illustrates an example of pine flooring in an old barn which was damaged by one species of this class of insects.

The conditions in new or old buildings favorable for attack by white ants (fig. 52) are decayed or moist wood in the underpinning and foundation timbers which are near the ground, or the location of buildings in the vicinity of decaying wood of any kind in which the insects are breeding. After a building is once infested, however, the destructive work is extended into sound and dry wood. Old logs and stumps are favorite breeding places for these insects, from which they may travel or fly to a considerable distance to reach suitable places to extend

their work; therefore, it is important that all such material should be removed previous to the construction of buildings to prevent danger. The creosote treatment of frame timbers would doubtless prevent the attack of powder post borers.

WOODWORK IN WAGONS, FURNITURE, ETC.—This is often seriously damaged or destroyed by powder post borers (fig. 50), which are introduced by the use of infested wood, in which they continue to work regardless of paint and subsequent external treatment.

STAVES AND HEADINGS OF BARRELS CONTAINING ALCOHOLIC LIQUIDS.—These are liable to attack by ambrosia beetles (figs. 43, *a*, and

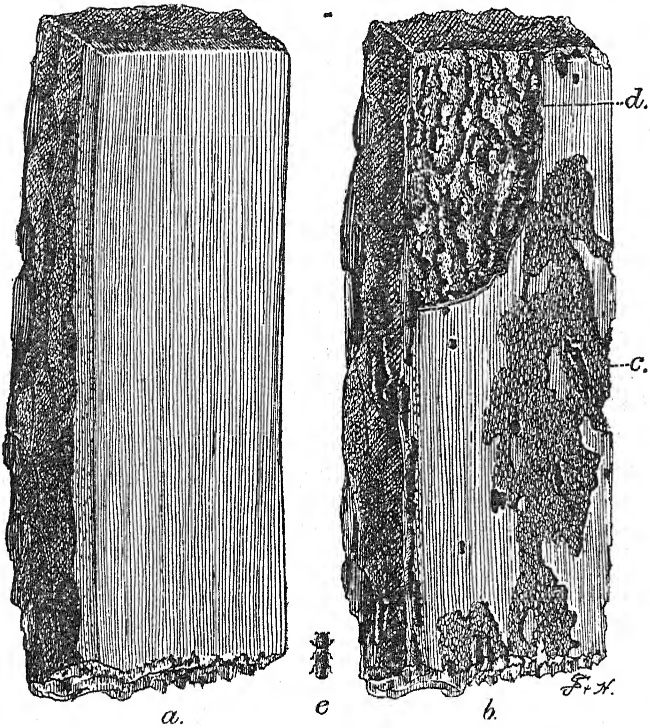


FIG. 55.—Work of the hemlock tanbark destroyer, *Dinoderus substriatus*: *a*, bark less than three years old, uninjured; *b*, bark over three years old; *c*, surface of inner bark eaten by adults; *d*, inner portion destroyed by larvæ and adults; *e*, adult, natural size. (Original.)

45, *a*), which are attracted by the moist condition, and possibly by the peculiar odor of the wood, resembling that of dying sapwood of trees and logs, which is their normal breeding place. There are many examples on record of serious losses of liquors from leakage caused by the beetles boring through the staves and headings of barrels and casks in cellars and storerooms.

The condition, in addition to the moisture of the wood, which is favorable for the presence of the beetles is proximity to their breeding

places, such as the trunks and stumps of recently felled or dying oak, maple, apple, and other hardwood or deciduous trees; lumber yards, sawmills, freshly cut cordwood from living or dead trees, and forests of hardwood timber. Under such conditions the beetles occur in great numbers, and, if the storerooms and cellars in which the barrels are kept are damp, poorly ventilated, and readily accessible to them, serious injury is almost certain to follow.

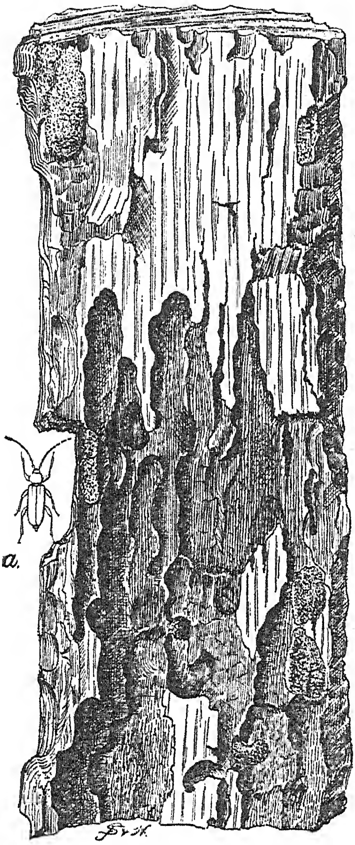


FIG. 56.—Work of round-headed borer, *Phymatodes variabilis*, in oak tanbark: *a*, adult. (Original.)

TANBARK.—Favorable conditions for insect attack and injury to tanbark (figs. 55 and 56) are found in that which is over three years old from the time it is taken from the tree. This suggests at once a simple and practical method of preventing losses—that of labeling the different lots, or piles, with the year the bark was peeled, and then utilizing it before it is old enough to be in danger of attack. While it is a common practice for tanners and dealers to keep a record of the age for other reasons, the utilization of the bark within three years is by no means universal, as was demonstrated by the writer's investigation at one tannery, where $50,000 to $75,000 worth of old hemlock bark was found to have been rendered almost worthless, while the remainder of the bark in the yards, which was less than three years old, showed no damage whatever.

PROMISING NEW FRUITS.

By William A. Taylor,
Pomologist in Charge of Field Investigations, Bureau of Plant Industry.

INTRODUCTION.

So long as improvement of fruits continues, whether through chance variation or through systematic selection and breeding, it will be necessary for the progressive fruit grower to keep in touch with the advances that are being made along the particular lines in which he is interested. The largest profits in commercial fruit growing not infrequently result from judicious planting of comparatively new varieties which have shown strong indications of adaptability to particular regions or to special uses before either of these points has been fully established by actual experience. It is the purpose of the series of Yearbook papers to which the present article belongs[a] to direct the attention of fruit growers to some of those new or little-known varieties of important fruits which appear worthy of testing in different parts of the country.

BLOOMFIELD APPLE.

(Synonyms: *Bentley's Seedling, Bloomfield Bentley.*)

[PLATE L.]

This very promising autumn variety for the home orchard and near-by market originated as a chance seedling which came into bearing about 1880 at Bloomfield, the farm of the late Richard T. Bentley, of Sandy Spring, Montgomery County, Md. Its fruit was found to be so excellent in quality, as well as so handsome in appearance, that it was quite widely disseminated throughout Montgomery and Prince George counties, Md., by top grafting trees in established orchards. Soon thereafter it was commercially propagated by the late Chalkley Gillingham, of Accotink, Fairfax County, Va., and other local nurserymen of Maryland and Virginia, so that it is now quite widely disseminated through the family orchards of the Potomac River counties of both States. Prior to 1894 it was known as "*Bentley's Seedling*," but the attention of Mr. John C. Bentley, the present owner of the farm on which the variety originated, having been called to the

[a] See Yearbooks of the Department of Agriculture for 1901 (p. 381), 1902 (p. 469), and 1903 (p. 267).

close similarity of this name to "Bentley Sweet," an old established variety with which it was in danger of being confused by the public, he consented to the adoption of the name "Bloomfield (*Bentley*)," under which it was described in the Report of the Pomologist of the Department of Agriculture for that year (p. 17).

The variety bears a group resemblance to the "English Red Streak" of the Middle Atlantic States, and is probably a seedling of that sort.

DESCRIPTION.

Form roundish or broadly cylindrical, truncate; size large; surface smooth; color yellowish, washed with crimson, striped with darker red and overspread with gray; dots conspicuous, sometimes triangular, protruding, russet, some having dark centers; cavity angular, large, deep, abrupt; stem short, rather stout, often knobbed; basin wide, deep, abrupt, furrowed and slightly leather-cracked; calyx segments short to medium, sometimes reflexed; eye large, open; skin thin, tough; core of medium size, conical, clasping; seeds few, plump, brown; flesh yellow, with a darker core line, moderately fine, tender, juicy; flavor subacid, rich; quality good to very good for both dessert and culinary use. Season, September to November in Montgomery County, Md.

Tree a rather stocky and vigorous grower, requiring strong soil, and an abundant annual bearer. This variety has for a number of years proved to be one of the best apples of its season in the Washington markets, and is worthy of wider dissemination both for home use and market.

The specimen illustrated was grown by Mr. Thomas O. Duvall, Spencerville, Montgomery County, Md.

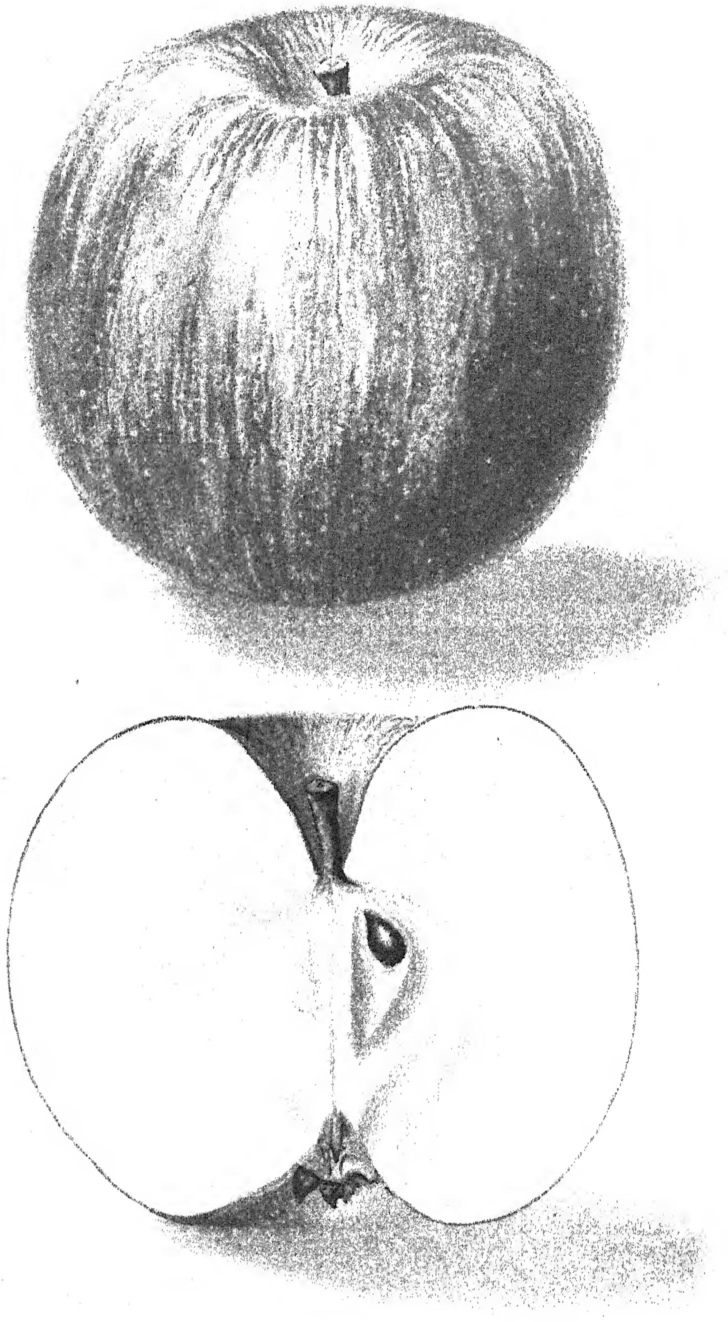
DOCTOR APPLE.

(SYNONYMS: *American Nonpareil* of Mease and Thacher, but not of Coxe or Downing; *Dewitt, Doctor Dewitt, Red Doctor, Newby.*)

[PLATE LI.]

Though included in Mease's list of "Apples most commonly cultivated"[a] in the United States a century ago, the real merit of this variety appears to entitle it to a place among the promising sorts throughout a wide range of climate. The fact that Mease, in the first published description of the variety, above cited, appears to have confused it with American Nonpareil, a summer apple, possibly accounts in part for the long period of obscurity from which it now appears to be emerging. Most of the early American writers mention it, but in several instances it is doubtful whether they were familiar with the

[a] Willich's Domestic Encyclopedia, first American edition; with additions, by James Mease, M. D., Philadelphia, 1804. Vol. III, p. 111.



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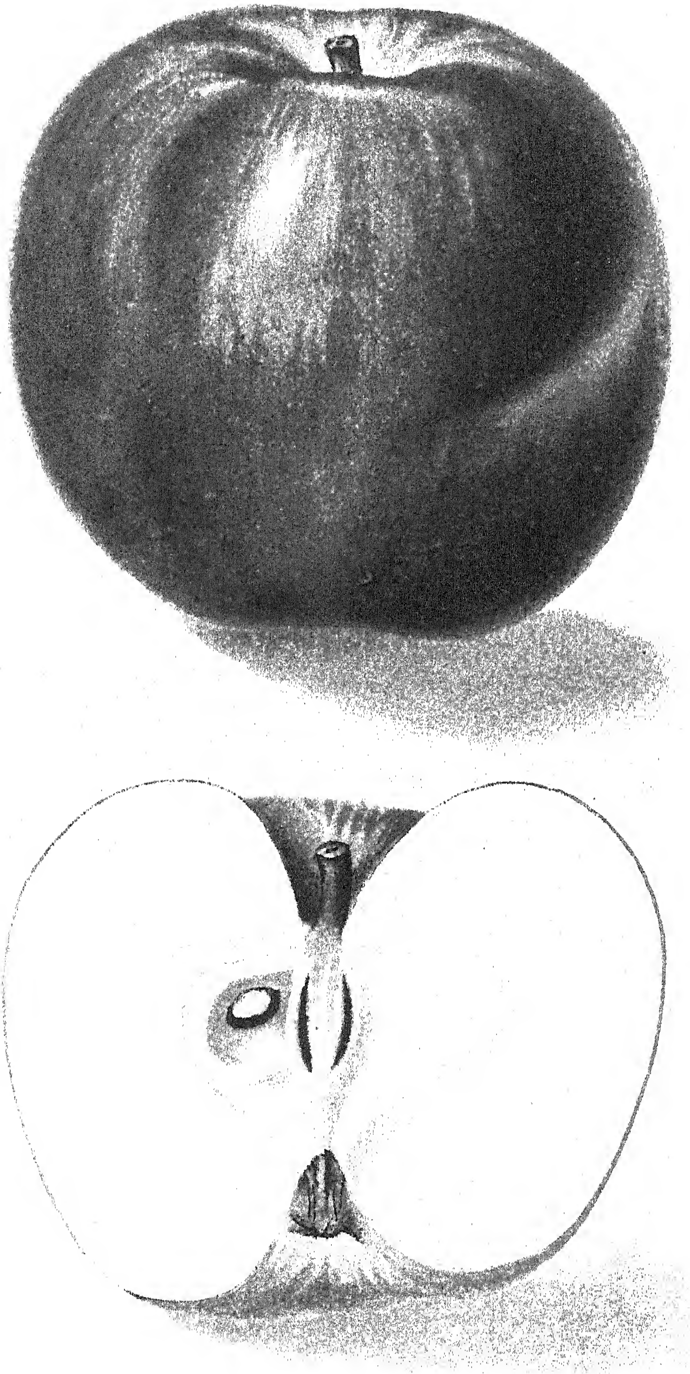
BLOOMFIELD APPLE.



DOCTOR APPLE. D. G. Passmore

true sort, which evidently possesses high merit in several important points, and gives evidence of becoming a popular variety.

Its rediscovery, after remaining practically an unknown sort except in a few widely scattered localities, is due to Mr. Thomas T. Newby, of Carthage, Ind. Mr. Newby's father grafted a tree with scions from a tree of unknown identity in an orchard in that vicinity in 1854, and some twenty years later Mr. Newby himself grafted a small seedling tree of the same variety. Being impressed with the beauty, symmetry, and uniform size of the fruit, which he found to be of fair dessert quality, Mr. Newby, who had supposed it a well-known old variety, became convinced of its value when he found that the severe winter of 1880–81, which nearly ruined the orchards in his section, did not injure it. He then undertook to ascertain its identity, submitting specimens to experts and exhibiting the variety at State and other fairs repeatedly with this end in view. These efforts having failed, a committee of the Indiana Horticultural Society in 1894, in commending its excellence, published it in the report of the society for that year under the name "Newby," and it was described under that name in the Report of the Pomologist of the Department of Agriculture for that year.

During the summer of 1900, among the old varieties which reached the Department were some specimens of Doctor from Mr. D. C. Boring, of Thornville, Ohio, and it was through these that the identity of Mr. Newby's apple was established. Meanwhile Mr. Newby had in the autumn of 1899 forwarded for exhibition in the American fruit exhibit at the Paris Exposition during the summer of 1900, a quantity of specimens of the variety, which attracted much attention by their symmetrical form and beautiful color. Scions were distributed by the Department in 1895 to a number of State experiment stations and individual growers throughout the more important northern apple districts, and from its behavior during the past four years it is considered well worthy of experimental planting for special markets from Maryland northward to Maine and westward to Lake Michigan. While not of the highest dessert quality, it is superior in this respect to a number of the standard commercial sorts and in beauty is surpassed by none.

DESCRIPTION.

Form oblate or roundish oblate, sometimes slightly oblique; size uniformly large; surface very smooth, glossy at ripening time, becoming very oily when stored under ordinary cellar or warehouse conditions; color a rich yellow, lightly washed with mixed red and indistinctly striped and splashed with crimson; dots scattering, russet, occasionally aureole; cavity regular, large, deep, with gradual slope, somewhat russeted; stem short, rather stout; basin regular, large, deep, furrowed and downy; calyx segments medium, converging,

sometimes reflexed; eye large, usually open; skin thick, tenacious; core medium, oblate conical, open, clasping; seeds numerous, plump, brown; flesh yellowish, moderately fine, breaking, juicy; flavor subacid, pleasant; quality good to very good. Season, October to January in Ohio and Indiana, keeping well in cold storage.

The tree is a stocky grower, making a rather upright head, and is a regular bearer of good crops.

The specimen illustrated was grown by Mr. D. C. Boring, of Thornville, Ohio.

ROSSNEY PEAR.

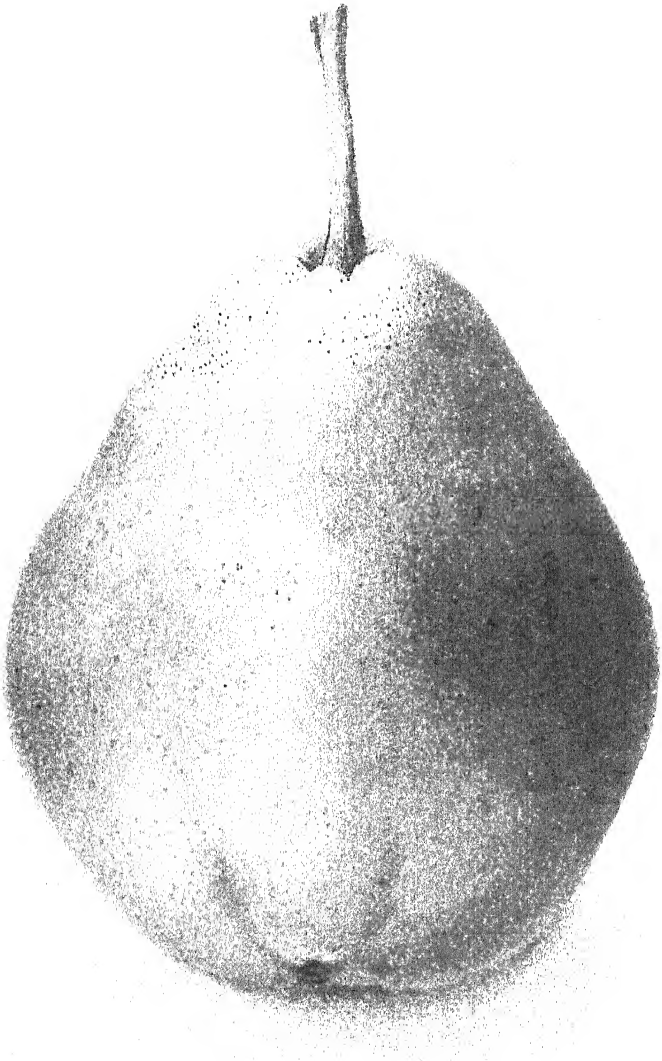
[PLATE LII.]

It is a noticeable fact that a much larger proportion of pear than of apple varieties that have attained important commercial rank in America are of European origin. In fact, outside of American varieties of the Oriental class, such as Le Conte, Kieffer, and Garber, very few American pears have become important in a commercial way. One of the most promising recent candidates for favor in this respect is the Rossney. According to the introducers, this variety originated in Salt Lake City, Utah, from a mixed lot of Winter Nelis and Bartlett seed planted for stocks by William Woodberry in 1881 or 1882. The peculiarly strong and vigorous growth of one of the trees and the distinctness of its foliage and wood caused the owner to save it when the rest of the seedlings were budded. It bore its first fruit at the age of 5 years and was propagated from in a small way by the owner shortly thereafter for his own planting under the name "Woodberry Seedling." The original tree was sold by Mr. Woodberry in 1891 to the Pioneer Nurseries Company of Salt Lake City, Utah, who named the variety "Rossney" in honor of Mr. William E. Rossney, of Bloomington, Ill., and introduced it in 1898. From observation of its behavior in several States since that time it is considered a promising variety for the commercial planter throughout the Northern and Middle States where Bartlett and similar varieties succeed.

DESCRIPTION.

Form oval pyriform, somewhat angular and ribbed toward the apex; size large, surface undulating and somewhat uneven; color golden yellow, blushed with scarlet and thinly overspread with a bluish white bloom; dots numerous, minute, russet, indented; cavity regular, of medium slope and depth; stem rather long, moderately stout; basin regular, small, abrupt, shallow; eye small, closed; skin thin, tenacious; core oval, medium in size, meeting the eye; seeds few, small, brown; flesh yellowish, buttery, juicy; flavor mild subacid; quality good to very good. Season about ten days later than Bartlett.

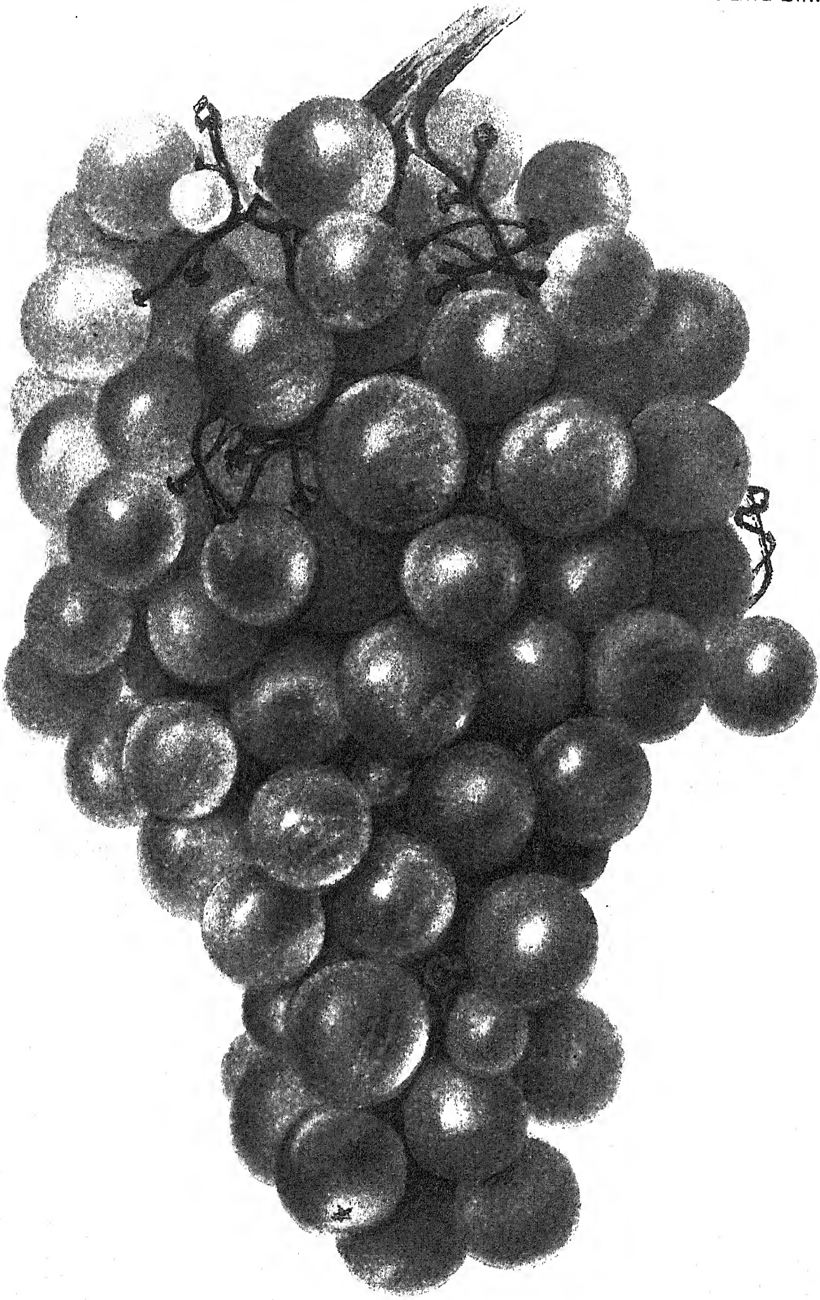
The original tree is a strong and vigorous grower, erect in habit, and thus far free from blight, and the young trees now in orchards



D. G. Passmore.

SACKETT & WILHELMS LITHO & PTG CO. N.Y.

ROSSNEY PEAR.



SACKETT & WILHELMS LITHO & PTG CO.N.Y

MILLENNIAL GRAPE.

D. G. Passmore.

through the Eastern States are also reported free from blight injury up to this date, although in localities where the disease is present.

The specimen illustrated on Plate LII was grown at Salt Lake City, Utah.

MILLENNIAL GRAPE.

(SYNONYMS: *Hungarian Millennium*, *Ezeréves Magyarország Emléke* of Hungarian nurseries.)

[PLATE LIII.]

New varieties of the Vinifera class of grapes which differ sufficiently from existing sorts to warrant introduction and naming are now of rare occurrence. In fact, the limit of variation along desirable lines except through hybridization with other species of grapes appears to have been nearly reached. It is, therefore, worthy of note that a variety recently originated in Hungary, which was introduced into this country in 1897, in the form of cuttings received from Mr. Sigmund Katona, of Kecskemet, Hungary, possesses characteristics which mark it as an apparent exception to the general rule. This variety, which, according to its originator, is the result of a cross between Chasselas Doré (synonym *Queen Victoria White*) and Calabre, was grown by Mr. Johann Mathiasz, of Kecskemet, from seed planted in 1887. It was named in 1896 in honor of the millennial of the establishment of the Hungarian Government, which was then being celebrated. The points of special excellence claimed by the originator are the strength, vigor, and productiveness of the vine and the exceptional beauty, fine flavor, and excellent keeping and shipping quality of the fruit.

Its record in Napa County, Cal., where it has been fruited on grafted vines since 1899, bears out these claims in large degree, and indicates that it is especially promising as a table grape of high quality, as well as adapted to the making of high grade white wine.

The following field characterization of the variety is based upon specimens grown by the late Prof. George Husmann, of Napa, Cal., who was the first to fruit and report upon the variety in America, so far as known.

DESCRIPTION.

Bunch medium to large, compact, shouldered; berries large, round, resembling Malaga in shape and size; color yellowish white with a brownish blush on sunny side; skin transparent, thin, but tough; flesh quite tender and juicy, having a very sweet, pure flavor; seeds few; quality very good, keeping and enduring shipment well. Season, September, in Napa County, Cal.

Vine a strong grower, with close joints; apparently well adapted to close or stool pruning; very productive, showing after the first crop an abundant second crop of good-sized bunches and berries; leaf large and heavy, heartshaped, not lobed.

As it is a pure Vinifera it is, of course, unlikely to succeed outside of the recognized districts where that species can be profitably grown.

The cluster illustrated on Plate LIII was grown by Mr. Fred. L. Husmann, Rutherford, Cal.

PERFECTION CURRANT.

[PLATE LIV.]

This variety was originated by Mr. C. G. Hooker, of Rochester, N. Y., from seed of the Fay, the blossoms of which were crossed with White Grape in the spring of 1887. It was the best of a lot of 25 seedlings of same parentage, and after being held under observation by the originator for several years, was first propagated for experimental distribution about 1895. Its value having been satisfactorily established through several years of comparative tests beside other varieties, and after critical examination for three years by a committee of the Western New York Horticultural Society, it was awarded the Barry gold medal of that society in 1901 for a new fruit of superior merit. It was commercially introduced by Messrs. C. M. Hooker & Sons, of Rochester, N. Y., in 1902, and has been favorably reported upon by experiment stations and growers in several of the Northern and Eastern States.

DESCRIPTION.

Cluster long, cylindrical, tapering but slightly, with a long stem; berries spherical, uniformly large, adhering tenaciously to the short, stout pedicels; color bright crimson; skin thin, moderately tough; flesh tender, translucent, juicy; seeds medium in size and number; flavor sprightly subacid; quality good to very good, both for dessert use in the fresh state and for cooking.

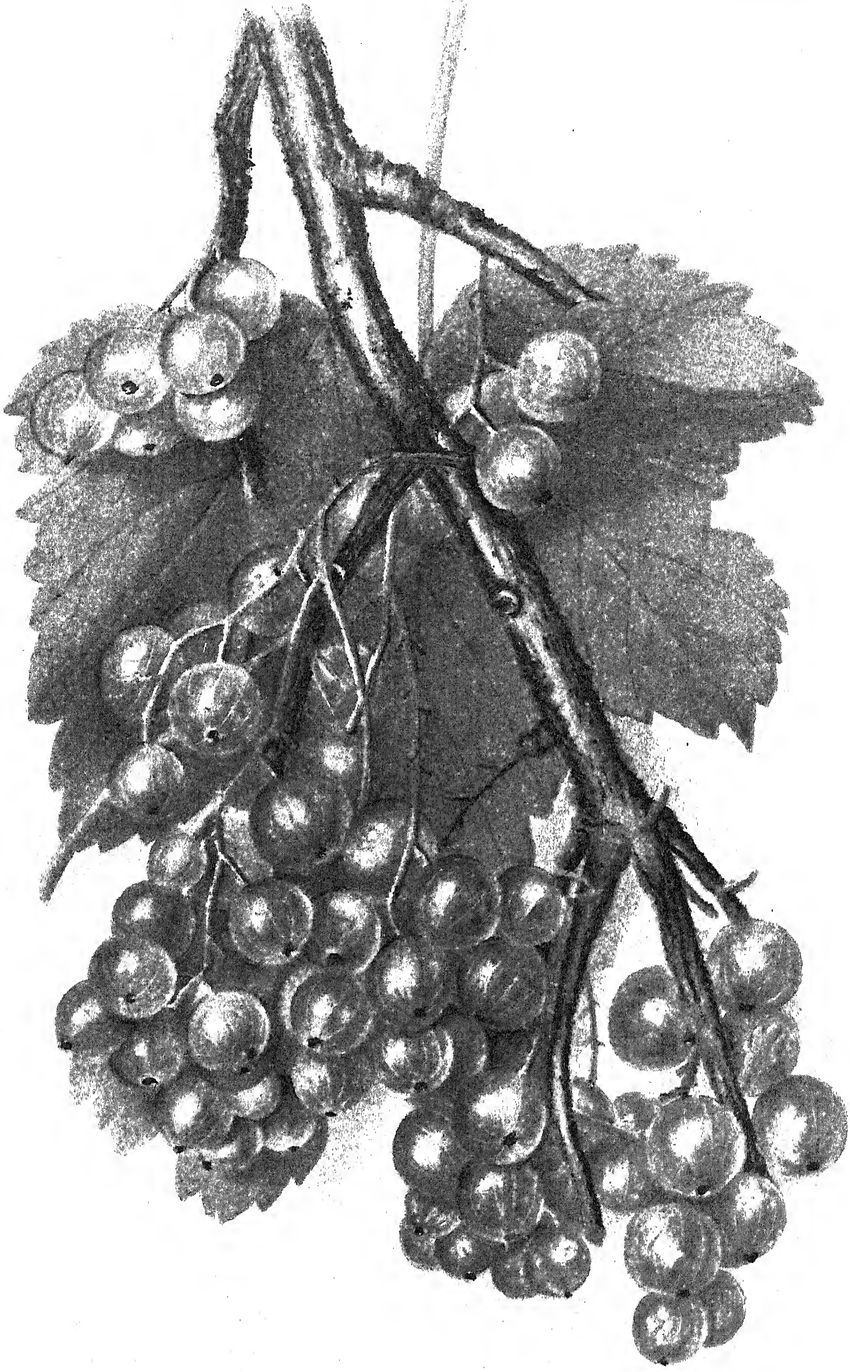
Bush a moderately strong grower with good foliage; bears its fruit chiefly on the old wood like its staminate parent, the White Grape.

The specimens illustrated on Plate LIV were grown by Mr. C. G. Hooker at Rochester, N. Y.

DELMAS PERSIMMON.

[PLATE LV.]

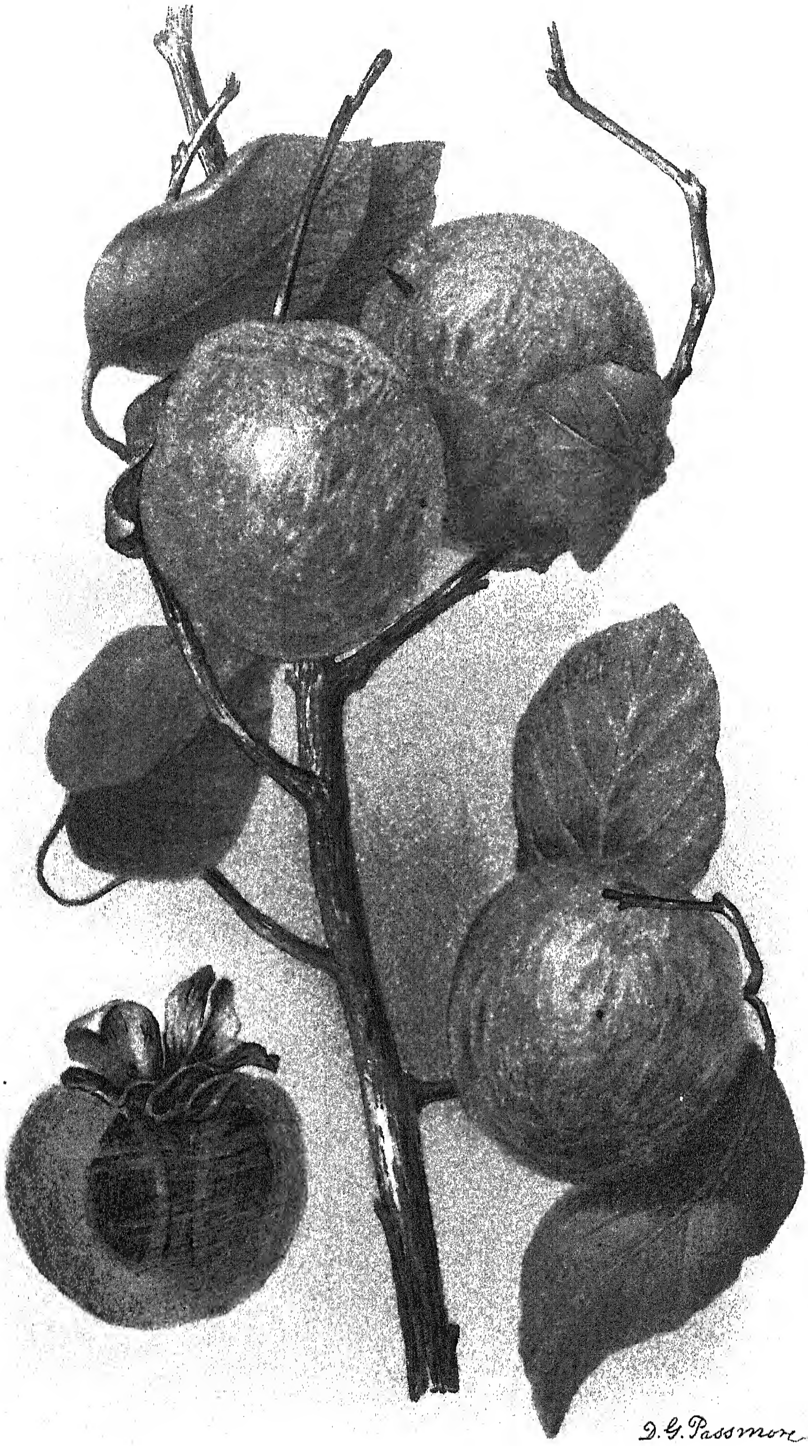
The native persimmon of the Southern and Eastern States, *Diospyros virginiana*, has but recently begun to receive the attention of cultivators, although wild trees yielding fruit of exceptionally fine quality or possessing other important characteristics have long been known to individuals in many portions of its range. In fact, until its larger fruited relative the kaki, or Japanese persimmon, was introduced and fruited in many parts of the South the intrinsic merit of the native species, and its inherent value as a fruit possessing large capabilities of



SACKETT & WILHELMS LITHO & PTG CO.,N.Y.

PERFECTION CURRANT.

D. G. Passmore.



DELMAS PERSIMMON.

improvement through selection of wild varieties already existing, seems to have been overlooked. Attention has been called to several choice varieties, in the reports of the Pomologist of the Department of Agriculture from time to time, especially to Early Golden, Golden Gem, and Marion. At the present time not fewer than 35 varieties have received names and are being grown in an experimental way.

One of the best of these varieties that have reached the office of the Pomologist is the Delmas, a native seedling on the grounds of Mr. A. G. Delmas, of Scranton, Miss., who, after observing its superior quality for some twenty years, planted 26 suckers from it in orchard form in a suitable location on his place in 1899. These trees, which were in bearing in 1902, attracted the attention of the writer in November of that year by their good size, handsome appearance, and fine quality. Later Mr. Delmas furnished the Department scions for experimental distribution, so that the variety is now under test in several localities.

DESCRIPTION.

Form roundish oblate; size medium to large; surface smooth; color reddish yellow, covered with a thin whitish bloom, remaining bright when full ripe; cavity regular, of medium size and depth; calyx, consisting of four medium-sized bluish green sepals, somewhat reflexed when fruit is ripe; apex slightly protruding; skin thin, tenacious; flesh yellowish, translucent, meaty; flavor sweet and rich; quality very good; seeds 7 or 8, rather large, dark brown. Season, October and early November, in southern Mississippi.

The tree is a strong grower, of upright habit, with large leaves. It is very precocious and productive. The variety is considered especially promising for experimental commercial planting in the Gulf States, because of its productiveness and the large size, bright and durable color, and fine quality of the fruit.

The specimens illustrated on Plate LV were grown by Mr. A. G. Delmas, of Scranton, Miss.

PECANS.

[PLATES LVI AND LVII.]

Of our native nut-bearing trees none promises to become of such pomological importance as the pecan. Within the region to which it is well adapted for cultivation, which may be roughly stated as the Mississippi Valley below St. Louis, the South Atlantic, and the Gulf States, including Texas, no other nut tree, either foreign or introduced, can be considered as fairly in competition with it. Though long neglected as a possible profitable orchard tree, it has, during the past fifteen years, assumed considerable importance, and extensive orchards have been planted in most of the Southern States. Previous to about

1900 most such orchards were planted with seedling trees or with nuts of particular varieties, which were placed at desired orchard distances and allowed to germinate and grow where the future trees were to stand, thus avoiding the transplanting process. As the earlier seedling orchards have come into bearing it has become increasingly apparent that the seedlings from trees of those exceptionally fine varieties which the orchardist desires to perpetuate vary too greatly from their parent types to be of much commercial value. Such seedlings rarely bear nuts closely similar to the parent in size, form, color, thinness of shell, plumpness of kernel, or dessert quality, and still more rarely do they reproduce the desired productiveness, ripening time, or other important characteristics that determine the commercial value of the tree. The necessity of relying upon budded and grafted pecan trees for commercial orchards is now very generally recognized by intelligent planters, so that at the present time few seedlings are being planted.

Unfortunately, much confusion exists among growers as to the exact identity and proper nomenclature of several of the leading sorts. This is partially due to the fact that for many years the locations of the original trees were not known to the general public, and partially to the fact that in certain instances deliberate renaming of varieties previously introduced was practiced by certain nurserymen and dealers in seeds and trees. The situation has been further complicated by a somewhat general practice of selling seedling trees under the names of the varieties from which they were grown. The result of these practices is that many and diverse forms of the pecan are now found in orchards throughout the South under the names of some of the best-known sorts. These practices are now discouraged by the leading nurserymen and orchardists, and it is hoped that, through the educational campaign which has been inaugurated by the National Nut Growers' Association through the adoption of the code of nomenclature of the American Pomological Society and its application to the names of nut varieties in catalogues and other publications relating to the subject, these productive causes of confusion in the names and identity of varieties will soon cease to operate.

With a view to determining the exact identity of the varieties that have been longest introduced to cultivation, the ten sorts that have been advertised and propagated for a sufficient time to attain a wide distribution among planters are illustrated on Plates LVI and LVII. The writer has visited the localities where these varieties originated, and in the case of all except the Centennial (the original tree of which was destroyed in 1890) has inspected and photographed the original trees. The effort has been to illustrate nuts that fairly represent characteristic specimens of the varieties, including thickness of

shell and form, color, and plumpness of kernel, as well as the external characteristics. In all cases the nuts illustrated are from trees grown in the climatic regions where the varieties originated.

CENTENNIAL PECAN.

[PLATE LVI.]

The original tree of this variety stood on the Anita[a] plantation of Mr. Amant Bourgeois, on the east bank of the Mississippi River, in St. James Parish, La., from some date early in the nineteenth century until March 14, 1890, when it was destroyed by the disastrous Anita crevasse, which swept away, to the depth of 15 feet, the earth in which it stood. Whether it was a chance seedling or was grown from a planted nut is not known. So far as known, the first effort to perpetuate the variety by grafting was made by the late Dr. A. E. Colomb early in the "forties." Not succeeding in this effort, Doctor Colomb later cut scions from the original tree and took them to the late Telesphore J. Roman, owner of Oak Alley plantation, on the east bank of the river, whose slave gardener, Antoine by name, succeeded in grafting 16 trees near the mansion and quarters with this variety in the winter of 1846 or 1847. Somewhat later than this Mr. Roman had 110 trees grafted "in the large pasture which was forty arpents from the river" with the same variety, so that by the close of the civil war (1865) there were 126 grafted Centennial trees in bearing on this plantation. The plantation having changed hands shortly after the war, the later plantings of grafted trees were cut down to make way for sugar cane, although they were just reaching their most productive age and the nuts from them were then selling at from $50 to $75 per barrel.[b]

In 1876, Hubert Bonzano, who then owned Oak Alley, exhibited nuts from these grafted trees at the Centennial Exposition in Philadelphia. He was awarded a diploma based upon an examination by Prof. William H. Brewer, in which the variety was commended for its "remarkably large size, tenderness of shell, and very special excellence."[c]

It is not clear as to who first applied the name Centennial to the variety, but so far as ascertained it was first catalogued under that name by the late Richard Frotscher, of New Orleans, in 1885, the propagation of budded and grafted trees of it for sale having been begun about 1882 by William Nelson, who was associated with Mr. Frotscher in the pecan nursery business.

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[a] Personal statement of Emil Bourgeois, Central, La., October, 1902.

[b] Letters of Henry J. Roman and Prof. Alcée Fortier, of New Orleans, son and nephew, respectively, of Telesphore J. Roman, May to August, 1903.

[c] U. S. International Exhibition 1876, Reports and Awards. Group VI, Award 222, p. 46. Philadelphia, 1877.

So far as ascertained, the Centennial is the first variety of pecan that was successfully propagated by budding or grafting. It was also the first variety planted in commercial orchard form, with a definite view to producing nuts for sale, and one of the first three to be catalogued and offered for sale.

Two of the earliest grafted Centennial trees, above referred to, are still standing at Oak Alley. They were thrifty, productive, and in fine condition when inspected by the writer in the autumn of 1902. The date of their grafting by the slave Antoine (1846 or 1847), under Doctor Colomb's direction, marks the beginning of modern pecan culture.

DESCRIPTION.

Size large, average nuts running about 45 to 50 to the pound; form long, compressed cylindrical, gradually tapering to the wedge-shaped apex; base conical; color bright grayish brown with rather scanty purplish splashes toward apex; shell rather thick, partitions thin; cracking quality medium; kernel clear, reddish yellow, deeply and narrowly grooved, but quite smooth and separating easily from the shell; plump, solid; of delicate texture and flavor, quality very good.

The Centennial tree is a rather slender grower with grayish green young wood sprinkled with small light dots. It becomes pendulous as it attains age, and is on this account one of the handsomest varieties for parks or large lawns. It is slow to come into bearing, but appears to be a fairly regular cropper after attaining an age of about 15 years from bud or graft.

The specimens illustrated on Plate LVI were from one of the two surviving trees that were grafted in 1846–47 on Oak Alley plantation, Feitel, St. James Parish, La. They were furnished by the present owner of the plantation, Mr. A. M. Sobral.

FROTSCHER PECAN.

(SYNONYMS: *Eggshell, Frotscher's Eggshell, Olivier, Majestic.*)

[PLATE LVI.]

This variety was originated by the late Oscar Olivier in his garden beside the Bayou Teche at Olivier, Iberia Parish, La. The original tree, now owned by H. J. Pharr, is still healthy, vigorous, and productive. Its exact age is not known, but the indications are that it was planted subsequent to 1860. It appears to have been first propagated about 1882 by William Nelson, and first catalogued by the late Richard Frotscher as "Frotscher's Eggshell," in 1885. Locally it is still known as the "Olivier" pecan, in honor of its originator.

DESCRIPTION.

Size large, averaging about 45 to 50 nuts per pound; form cylindrical oval with broad, rounded base and blunt quadrangular apex; suture rather indistinct; color bright yellowish brown, with scattered purplish black splashes toward apex; shell thin to very thin, with thin partitions; cracking quality excellent; kernel brownish yellow, often shrunken, showing dark veins even in the fresh nuts; texture rather dry and coarse; flavor pleasant; quality medium.

The tree of Frotscher is a strong grower, of broadly spreading and sprawling habit, the young wood bright brownish green in color and conspicuously dotted. The variety is precocious and productive, but the faulty character of many of its kernels and their stale appearance, even when perfectly fresh from the tree, materially lessen its value as a commercial variety.

The tree characters of Frotscher are quite clearly reproduced in its seedlings, and, as many of these have been planted throughout the South, there is much confusion regarding the variety.

The specimens illustrated on Plate LVI were grown by Mr. B. M. Young, Morgan City, La.

Jewett Pecan.

[PLATE LVI.]

The original Jewett pecan tree was grown from a nut planted on what is now known as the Wilcox place, 1½ miles north of Scranton, Miss., by the little son of Charles M. Cruzat, about 1881, it being the only one obtained from a half dozen nuts purchased in New Orleans at a cost of 50 cents. Mr. Cruzat has no information regarding the source of the nuts which he purchased, but remembers that they were large, fine-looking pecans. The tree commenced bearing at the age of 7 years, and attracted the attention of the late Col. W. R. Stuart, of Ocean Springs, Miss., who purchased the crops for several years and cut scions for grafting in nursery. He introduced the variety in the form of grafted trees in 1893, naming it Jewett, in honor of Col. Stephen Jewett, of Crosby, N. C. The original tree is still standing, and is about 4 feet 7 inches in circumference, but is affected by a bark disease to which the variety appears specially susceptible, and is now bearing but light crops of nuts.

DESCRIPTION.

Size large to very large, varying from 45 to 55 nuts per pound; form long, angular, obovate, often constricted at middle, with a blunt quadrangular apex, which is often curved and beaklike; suture quite distinct; color dull reddish brown, with many purplish splashes, sometimes extending the full length of the nut; shell rather thick, with thin

partitions, cracking easily but adhering to the kernel; kernel long, wedge shaped, rather broadly grooved, bright in color, rather coarse in texture, and only fairly good in quality.

The Jewett tree is an erect, strong grower when young, and is at least fairly productive. It is apparently very susceptible to a bark disease which has attacked the original tree and many of those propagated from it. Aside from the large size and striking appearance of a portion of its crop there appears to be little to commend it to planters.

The specimens illustrated on Plate LVI were grown by the Stuart Pecan Company, Ocean Springs, Miss.

Pabst Pecan.

[PLATE LVI.]

The original tree of the Pabst pecan is one of a number of seedlings on the grounds of the late William B. Schmidt, of New Orleans, at his country place at Ocean Springs, Miss. These trees were grown from nuts from unknown sources obtained in New Orleans about 1875. The Pabst tree proved to be an especially strong grower, yielding nuts of large size and plump kernel, and was first propagated by Mr. Charles E. Pabst, of Ocean Springs, in 1890. It was named in 1893 in honor of Mr. Pabst by Mr. B. M. Young, of Morgan City, La., who has done much to clear up the uncertainties regarding names and to determine the relative merits of pecan varieties.

The Pabst tree was over 5 feet in circumference when badly damaged by a severe wind and rain storm October 9, 1893, which destroyed most of its top. It has been replaced by two thrifty sprouts from the root of the original tree, which in 1903 were good-sized trees, 27 and 21 inches in circumference, respectively, and bearing nuts.

DESCRIPTION.

Size large, averaging about 45 to 55 nuts per pound; form short, cylindrical, with a very blunt, broadly grooved apex; color dull gray, heavily splashed with purplish black; shell thick, hard; partitions rather thick; cracking quality medium; kernel plump, smooth, with broad grooves, bright straw color; texture fine; flavor delicate; quality very good.

The Pabst is a very sturdy, upright tree with stocky gray-green young wood, sparsely sprinkled with large dots. It appears to be fairly productive where it has been under test for a sufficient time to test its bearing habit.

The specimens illustrated on Plate LVI were grown by Mr. Charles E. Pabst, Ocean Springs, Miss.

POST PECAN.

(SYNONYM: *Post's Select*, in part.)

[PLATE LVII.]

The original tree of the Post pecan is a wild seedling on the farm of Mr. H. B. Freeman, on the Colorado River bottom, in San Saba County, Tex., near Milburn, McCulloch County. The farm was formerly owned by a Mr. Post, by whose name the variety was locally known prior to 1891, when Mr. Herbert Post, of Fort Worth, Tex., began purchasing the crop and advertising it and other pecans widely under the trade name "Post's Select." Little effort appears to have been made to perpetuate the variety by grafting until a comparatively recent date.

When examined by the writer in November, 1903, the original tree was in fairly thrifty condition, and had a circumference of 9 feet 8 inches at 18 inches from the ground. Its crop has varied from 1½ to 11 bushels per annum in recent years.

DESCRIPTION.

Size medium, averaging about 65 to 75 nuts per pound; form compressed, short, obovate, with a rather blunt, conical apex; color bright reddish yellow, showing very few purple splashes; shell thick, partitions thick, cracking quality medium; kernel clear, bright straw color, but deeply grooved and wrinkled; texture firm, compact, fine grained; flavor delicate; quality good.

The original Post tree is a moderately strong, upright grower, with rather slender, bright young wood with numerous small dots, and is quite regularly productive. The variety has been fruited on buds or grafts in but few places, and its behavior outside of the locality of its origin can not yet be determined.

The variety described is the true Post. In recent years an entirely distinct sort, the Hollis, which originated at Bend, San Saba County, Tex., and is a larger and apparently superior nut, has been distributed by the introducer under the name "Post's Select."

The specimens illustrated on Plate LVII were furnished by Mr. E. W. Kirkpatrick, of McKinney, Tex. They were from the original tree.

ROME PECAN.

(SYNONYMS: *Century, Columbia, Columbian, Mammoth, Pride of the Coast, Southern Giant, Twentieth Century.*)

[PLATE LVII.]

The original tree of the Rome pecan was grown from a nut planted by the late Sebastian Rome in his garden at Convent, St. James Parish, La., about 1840. The source from which the nut which he

planted was secured is not known. The variety appears to have been first propagated by Mr. William Nelson, who took scions from the tree about 1882, and it was first catalogued by Richard Frotscher in 1885 under the name "Rome." About 1883, the late Emil Bourgeois, of Central, La., secured scions from the original tree and top-grafted some seedling trees at his home on Rapidan plantation in the same parish. There it was christened "Pride of the Coast," and soon thereafter Mr. Bourgeois began its propagation in nursery under that name. This variety yields the largest nuts of any yet brought to notice, and has therefore been the subject of deliberate renaming by nurserymen and seedsmen more frequently than any other. This accounts for the diversity and number of its synonyms.

The original tree of the Rome is still standing in the Rome garden at Convent, La. It has been in a state of decrepitude for several years, and now yields but light crops of nuts, many of which have imperfect kernels.

DESCRIPTION.

Size variable, large to very large, 40 to 55 nuts per pound, selected samples running as large as 25 per pound; form oblong or cylindrical oval, tapering gradually to the wedge-shaped apex; color grayish, often heavily splashed and spattered with purplish black over most of the surface; shell thick, hard; partitions thick; cracking quality poor; kernel often shrunken or entirely "false;" color bright, texture rather coarse and dry; flavor fair, quality good when plump and well filled, but usually quite indifferent.

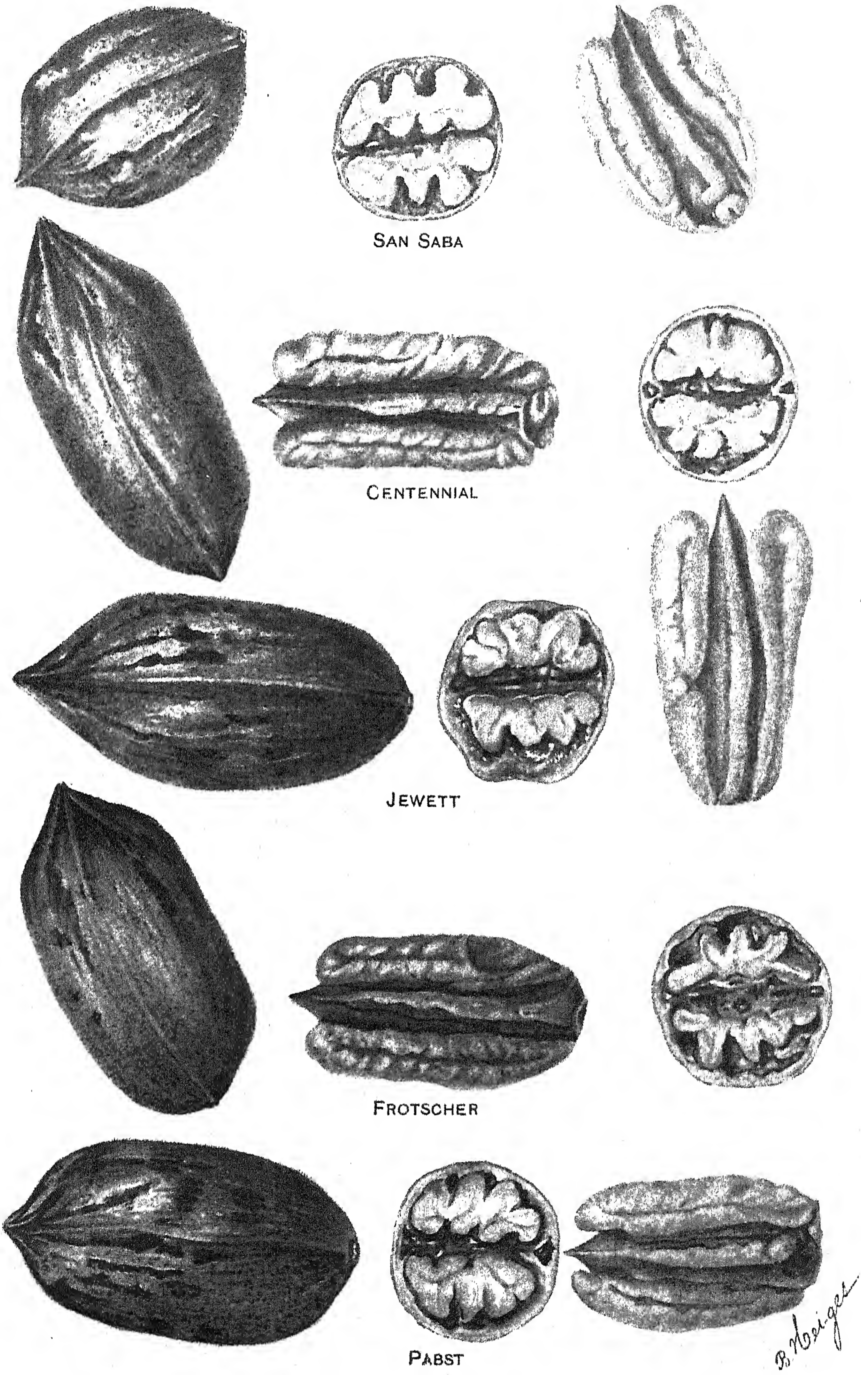
The Rome tree is an erect, fairly strong grower, with rather stout bluish-green young wood. It occasionally bears large crops, but is erratic in this respect, and at most points where it has been tested a large proportion of the kernels are defective. Aside from the fact that a portion of the crop is of extraordinary size, there is little to commend it to the planter.

The specimens illustrated on Plate LVII were grown by Paul E. Bourgeois, Central, La.

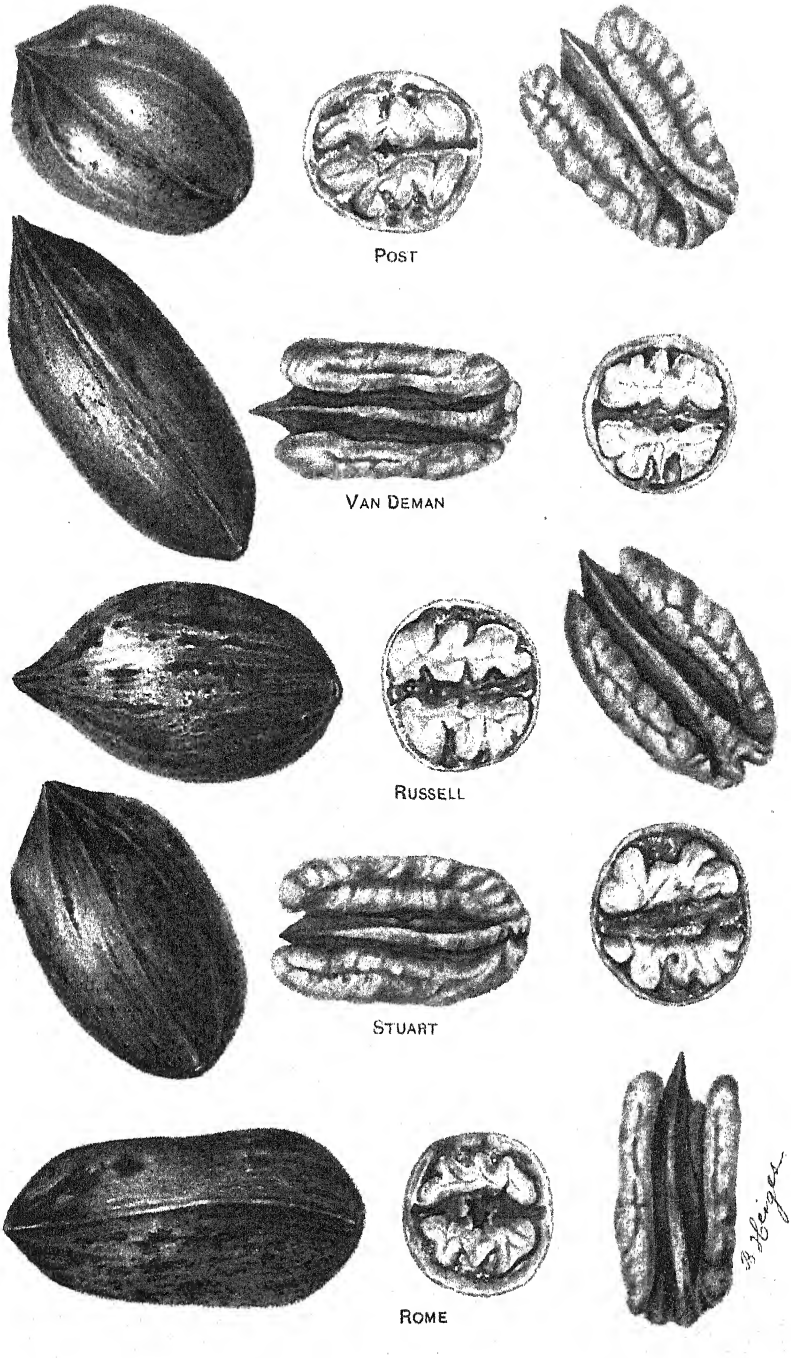
RUSSELL PECAN.

[PLATE LVII.]

The Russell pecan tree, like all others at Ocean Springs, Miss., was grown from planted nuts, that locality being below the native range of the species in that section. This tree was one of a lot of seedlings grown by the late Col. W. R. Stuart, of Ocean Springs, Miss., about 1875, from nuts secured by him from James Moore, a blacksmith of that village. The exact source from which Moore secured the nuts is not known. Colonel Stuart sold five of these seedling trees to Peter Madsen, who planted them in his garden, now the property of



PECAN VARIETIES.



SACKETT & WILHELMS LITHO & PTG CO N.Y.

PECAN VARIETIES.

Mrs. H. F. Russell. Of the five trees, four produced nuts of good size and thin shell, the largest and thinnest shelled one receiving the name Russell from Mr. Charles E. Pabst, who first propagated it in 1894. The tree is a fairly regular bearer, averaging about 150 pounds of nuts per annum, and, though receiving little care or attention, is a healthy, vigorous tree at present writing. It has attained a high local reputation on account of its exceptionally thin shell and regularity of bearing.

DESCRIPTION.

Size medium to large, 55 to 60 nuts per pound; form compressed, oval, tapering to a long, sharp apex and a rather pointed base; color grayish brown, with narrow splashes and spatters of purplish black; shell very thin, partitions very thin and fragile, cracking quality excellent; kernel broadly grooved, rather dark straw color, often lacking in plumpness and defective at tip, texture rather dry, flavor pleasant, quality good.

The tree is rather pendulous in habit, with slender, dark, conspicuously dotted young wood, bearing regularly and well, so far as tested.

The specimens illustrated on Plate LVII were grown by Mr. Charles E. Pabst, Ocean Springs, Miss.

San Saba Pecan.

(Synonyms: *Paper Shell, Risien's Paper Shell, Royal.*)

[PLATE LVI.]

The original San Saba tree is a native seedling on the San Saba River bottom, near the intersection of that stream with the Colorado of Texas. It came to the notice of Mr. E. E. Risien, its present owner, as the result of the offer of a $5 premium by him for the best pecan that should be brought to him with the privilege of purchasing its crop. He was so impressed with the superiority of this one that he purchased the farm upon which it stands in order to secure the tree, although he found that it had been so ruthlessly stripped of its top with ax and saw in harvesting the crop that only a single branch remained. After repeated failures in his attempts at grafting, Mr. Risien developed a method of annular budding, which is very successful with him, and which has enabled him to transform the tops of many large wild pecan trees into this choice sort, as well as to bud young seedlings in nursery for transplanting to orchard.

Mr. Risien formally introduced the variety under the name San Saba about 1893. The original tree is at present a fine, healthy specimen, with a girth of 9 feet 6 inches, bearing an average crop of about 180 pounds of nuts.

DESCRIPTION.

Size small to medium, averaging about 85 to 90 nuts per pound; form varying from long oval to oblong, with blunt apex; color bright, reddish yellow, strongly splashed toward apex with purplish black; shell very thin and brittle, though quite dense in texture; partitions thin; cracking quality very good; kernel plump, bright straw color, smooth and broadly grooved, almost invariably well filled; texture delicate, solid, fine grained; flavor very delicate; quality best.

The tree is a short-jointed, rather slender grower, enormously productive in the vicinity of its place of origin. It has not yet been fruited elsewhere to any extent, but is considered one of the best high-grade dessert varieties. On account of the thinness of shell, the nuts should be packed in relatively small boxes when shipped to avoid cracking in transit. Its small size is its only conspicuous fault.

The specimens illustrated on Plate LVI were grown by Mr. E. E. Risien, San Saba, Tex.

STUART PECAN.

(SYNONYM: *Castanera.*)

[PLATE LVII.]

The original tree of this, which is generally considered the most widely successful pecan variety yet introduced and tested, stood in a garden at Pascagoula, Miss., now owned by Capt. E. Castanera.

It is supposed to have grown from a nut brought from Mobile, Ala., by John R. Lassabe and planted about 1874.[a] It early acquired local celebrity on account of its productiveness and the beauty and fine quality of its product, its average yield from 1889 to 1892 being about 140 pounds per annum. In 1892 it yielded about 350 pounds of nuts, most of which were sold by Charles M. Cruzat, who then held the place under lease, at $1 per pound. It was first propagated by Mr. A. G. Delmas, of Scranton, Miss., who cut scions in 1886. Out of some sixty grafts inserted he secured one tree, which still survives in his garden. John Keller, then associated with Col. W. R. Stuart, of Ocean Springs, Miss., in the pecan-nursery business, secured scions from the tree about 1890, from which trees were propagated in nursery by them. The trees of the variety were offered for sale by Colonel Stuart about 1892, under the name Stuart, which had been suggested for it by Prof. H. E. Van Deman, then Pomologist of the Department of Agriculture, who was unaware of the name previously applied to it in the locality where it originated. Under the name Stuart it received wide advertising and distribution, so that it is one of the most widely disseminated varieties throughout the South. The original tree in Captain Castanera's garden was blown down in October, 1893, by the same storm

[a] Letters from Charles M. Cruzat, 1903.

which destroyed the top of the original Pabst tree at Ocean Springs. Some two years later a sprout from one of the roots appeared, which has developed into a symmetrical young tree, which bore its first nuts in 1902.

DESCRIPTION.

Size large to very large, averaging about 40 to 50 nuts per pound; form cylindrical, slightly compressed, with rather blunt apex and rounded base; color brownish gray, moderately splashed and dotted with purplish black; shell moderately thin; partitions thin and fragile; cracking quality very good; kernel bright, moderately smooth, plump, rather narrowly grooved; texture firm, fine grained, solid; flavor delicate, rich; quality very good.

The tree of Stuart is a strong, upright, spreading grower, with moderately stout young wood, grayish green in color, rather sparsely dotted with oval dots. It is proving regularly and abundantly productive in most localities where it has been fruited, and is apparently succeeding over a wider climatic range than any other sort thus far tested.

The specimens illustrated on Plate LVII were grown by the Stuart Pecan Company, Ocean Springs, Miss.

Van Deman Pecan.

(Synonyms: *Bourgeois, Duminie Mire, Mire; Mere,* and *Meyer* erroneously; *Paragon* in part, *Southern Beauty.*)

[PLATE LVII.]

The original tree of this variety was grown from a nut planted by the late Duminie Mire, of Union, St. James Parish, La., in 1836. Mr. Mire, then 25 years of age, secured nuts from a highly esteemed tree on the adjoining place of Mr. Gravois, which he planted in the garden surrounding his dwelling. Of the several trees that resulted from this planting only the one described here is considered worthy of perpetuation. Mr. Mire informed the writer, in October, 1902, that the product of this one closely resembles the nuts planted. This tree, which is locally known as the "Duminie," or "Duminie Mire," attracted the attention of the late Emil Bourgeois, who, about 1877, cut scions from it for propagation. Although this was his first effort at grafting, he succeeded in getting 11 scions to grow out of 22 that he set as top grafts on seedling trees near his residence on Rapidan plantation. When these grafts began bearing he commenced propagating young trees for planting in orchard form and for sale to the near-by planters, among whom it is known as the "Duminie Mire" pecan to this date.

A considerable quantity of nuts and some scions from these grafted trees having passed into the hands of Col. W. R. Stuart, of Ocean

Springs, Miss., about 1890, he renamed the variety Van Deman, in honor of Prof. H. E. Van Deman, then Pomologist of the Department of Agriculture. Since 1892 it has been widely advertised and distributed under that name, which has now become so firmly fixed in the literature of the subject as to make a return to the earlier local name inadvisable at this time.

About 1900, nuts and grafted trees of the variety were placed on the market by Herbert Post, Fort Worth, Tex., under the name Paragon.

The original tree still stands in the Mire garden, close to the Mississippi River levee, at Union Post-Office, La., and when inspected by the writer in October, 1902, was a beautiful, thrifty tree, measuring 7 feet 6 inches in circumference, and bearing from 200 to 300 pounds of nuts per annum.

DESCRIPTION.

Size large to very large, averaging 45 to 55 nuts per pound; form long, compressed, with a rather sharp base and a long, sharp apex, often slightly curved; color rather dark, reddish brown; slightly splashed with purplish black, especially toward apex; shell moderately thin, partitions rather thick but brittle; cracking quality fair; kernel long, narrowly grooved, generally plump, except at tip; color bright, clean, attractive; texture firm, fine grained; flavor delicate, rich; quality very good.

The Van Deman tree is of strong, moderately erect habit, with grayish-green young wood showing inconspicuous dots, and is a regular and abundant bearer in the locality of its origin. It does not thus far appear to be as productive elsewhere nor to fill out its kernels as well.

The specimens illustrated on Plate LVII were grown by Mr. Paul E. Bourgeois, Central, La.

CONSUMERS' FANCIES.

By George K. Holmes,
Chief of Division of Foreign Markets, Bureau of Statistics.

QUESTIONS OF ART AND PSYCHOLOGY.

So precise have many farmers and dealers become in their estimation of the nature and value of consumers' fancies, that they analyze them and translate them into sense impressions, and give numerical weights to these impressions more accurately than they could guess the weight of a hog or the number of bushels in a corn crib.

The growing, the preparing, and the marketing of many of the products of the farm are becoming questions of art and psychology. Less do people eat to live than they live to eat, and yet when they buy food, they buy it often not primarily for the gratification of taste, but upon the testimony of the eye, which is pleased with form and color, and upon the perception of odor, while, if the consumer was reared in the country, perhaps his choice is determined by the farm-bred fancies of a happy youth.

What set of nerves shall have the preference in determining the purchase of a farm product, the optic or the gustatory? Shall a thing be pretty, or delicious; and, since the sense of smell must also be consulted in some cases, is it of much consequence whether it is pretty or delicious? The seller has much more definite information with regard to these questions than the consumer; although it is the consumer who makes the choice, he is induced to do so by the seller's subtle knowledge of his fancies, which need not be and often are not either sensible or reasonable, but, on the other hand, often verge upon the notional, and seem superfluous to an unsophisticated farmer.

BUTTER JUDGED BY EYE, NOSE, AND TOUCH.

Butter is an article of food, and, as all but its makers and sellers believe, it is bought mainly for food reasons; yet, upon mental analysis, it appears that butter is not bought alone for its nutritive value. But, surely, then, it must be bought for its taste? Hardly so, if the commercial men know their business. As a matter of trade experience they know that the consumer gives almost as much weight to the combined testimony of the senses of sight and touch, and sometimes

smell, as he does to the sense of taste. This will appear upon examining the butter score of excellence in use by the New York Mercantile Exchange and generally in use by dairymen.

WEIGHT GIVEN TO FLAVOR IN BUTTER SCORES.

Flavor, appealing to the gustatory nerves, has a weight of 45 points; the grain, body, or texture, which is perceived by the nerves of touch in the mouth, particularly those of the tongue, has a weight of 25 points; the salting, 10 points; the color of the butter, 15 points; and the style of the package, 5 points—altogether making 100 points, indicating perfect butter upon full scoring.

The nerves of taste influence the choice of the purchaser to the extent of only 55 per cent; to the nerves of touch in the mouth is granted an importance of 25 per cent; so that butter appeals to the mouth to the extent of 80 per cent of its attractions, the remaining 20 being offers to the favor of the eye.

Although these allowances are in common use, there are some notable deviations from them. The butter score of the Louisiana Purchase Exposition gave 30 points to flavor, 15 to aroma (which is not generally a part of the score), 25 points to texture, 15 to color, 10 to salting, and 5 to package. In this case the common allowance of 55 per cent of points to the gustatory nerves was cut down to 40, leaving the sum of 60 per cent for the allowance to touch, eye, and nose. The Michigan Dairymen's Association raises the weight for texture to 30 as compared with the ordinary weight of 25, and the Iowa State Dairy Association has 60 for the weight of taste in place of the common 55.

A considerably different scoring is in use by the Dairy Division of the Bureau of Animal Industry of this Department in judging butter for export, the allowance for flavor being reduced from the customary 45 to 40, the color and salt from 25 to 10, without separation, while that for texture is raised from the customary 25 to 40, and the style of the package from 5 to 10.

Under the Dairy Industry Act of New Zealand, the Department of Agriculture has established a butter score in which flavor has 50 points; body, moisture, texture, 25 points; color, 10; salt, 10; and finish, 5. Thus, the nerves of taste perceive 60 per cent of the excellence, and those of taste and touch combined 85 per cent.

TASTE OF MINOR ACCOUNT IN JUDGING CHEESE.

In the estimation of the cheese expert the consumer buys cheese with less regard for flavor than in the case of butter, more for touch with the tongue, and more for eye pleasure, while at the same time entirely ignoring every qualification of this food for aiding bodily repair and growth.

CHEESE SCORES.

The usual cheese score is the one adopted by the dairymen's associations of Wisconsin, Vermont, and Ontario, and by the government of New Zealand, and assigns 45 points to flavor, 30 to texture or body, 15 to color, and 10 to finish. Hence, it appears that for commercial purposes—that is, for the purposes of attracting and pleasing consumers—only 45 per cent of the perfection of cheese is regarded as appealing to the taste. Almost one-third of the total of excellence, or 30 per cent, is perceived by touch in the mouth, and 25 per cent, or one-fourth, is purely an appeal to the eye.

These allowances of excellence have variations here and there, but generally for special purposes. The Michigan Dairymen's Association reduces the percentage for texture from 30 to 25, and for color from 15 to 10, but raises the finish from 10 to 12, and adds the percentage of 8 for salt. This gives to taste 53 per cent of the points and to the various nerves of the mouth, gustatory and touch, 78 per cent, in consequence of which the points assigned to the eye are 22 per cent.

The score for export cheese varies somewhat from the customary one, and is as follows: Flavor, 40 per cent; texture, 30; color and salt, without separation, 10; finish, 10; package, 10 per cent. In experiments conducted by the Dairy Division in keeping cheese in cold storage at different temperatures for different lengths of time, in testing the cheese at the termination of the experiments a score was used in which flavor was rated at only 25 per cent and texture was raised to 50 per cent, the customary allowance of 15 points being made to color and 10 points to finish. Here the allowance to taste was but slightly more than half the customary amount.

FRUIT PREFERENCES MOSTLY FANCIFUL.

QUALITY NOT RELATED TO OTHER FRUIT CHARACTERISTICS.

Horticulturists have been saying for years that in the so-called improvement of fruits we have generally failed to improve the quality. The most productive of cultivated blackberries are large and beautiful, but, as found in the market, are inferior in flavor when compared with the wild ones found along the roadside. As Professor Bailey has said, "the best market fruits are cultivated for a variety of features, as size and color of fruit, vigor, hardiness, and productiveness of the tree; quality is usually not considered. * * * Quality and other characters of cultivated fruits appear independently of each other, and there is no true correlation between these characters."

VAGARIES OF APPLE BUYERS.

Place a farmer and a city-bred man in the presence of a large variety of apples, and the farmer, very likely, will select for his eating such apples as a Rhode Island Greening, a Northern Spy, a Grimes' Golden, or a Jonathan, and the city man, governed in his choice by different sets of nerves, may select a Ben Davis, Baldwin, Stark, or Missouri Pippin. Taste is the fruit grower's principal test of an apple, if he has to eat it himself, but very different attributes are of chief importance when he considers consumers in general, most of whom are townspeople.

Apples desired for ornamental purposes.—In the city, a large city especially, the appearance of an apple is everything and taste nothing, unless the purchaser was once a country boy and enjoyed the freedom of an orchard. For some reason red is a leading favorite as an apple color in this country; indeed, there are some red apples that are miserably poor for eating purposes which sell for good, if not high, prices—the principal attraction to the consumer apparently being the red color, with subordinate attractions in smoothness and shapeliness.

At the annual meetings of Eastern horticultural societies it is not uncommon to witness the indignation of the various members directed against the commercial preference for apples with attributes that appeal to the eye rather than to the taste. For some subtle reason this delicious fruit, this "king of fruits," is taking a place in the cities alongside the wax apple, and has an increasing use for decorative purposes. There seems to be no reason why red should be preferred unless because the red ray of light sends many millions less of light waves per second to the retina of the eye than does the green or yellow ray.

Apple scores.—In illustration of this subject it is instructive to turn to the fruit score of the Louisiana Purchase Exposition. In a total of 100 points of excellence, 20 were given to the extent of the exhibit, which of course is excluded from this discussion. In the case of apples, to size were given 15 points, color 15, form 15, quality 15, and freedom from blemishes 20. Every item but quality is designed for the eye, and consequently 81 per cent of the maximum excellence appeals to the sight and only 19 per cent to the taste.

A somewhat different score of points for apples is in use by the Ontario Fruit Growers' Association. It gives 5 points to form, 15 to size, 20 to color, 15 to quality, 20 to uniformity, and 25 to freedom from blemishes. Thus, the extremely high percentage of 85 is given to features that please the eye.

NOTIONS CONCERNING PEACHES, PEARS, PLUMS, CHERRIES, AND GRAPES.

Scores adopted at the Louisiana Purchase Exposition.—In the case of peaches at St. Louis, larger weights were given to size, color, and quality than in the case of apples, or 20 points each, and

only 10, respectively, to form and freedom from blemishes. These weights give to peaches eye-pleasing qualities which are 75 per cent of the total, and to taste 25 per cent.

A similar result is found in the case of pears, but by a different process, because pears have the weights of apples in size, color, and freedom from blemishes, a smaller weight in form, and a larger one in quality.

Again, in the case of plums we find 25 per cent given to taste and 75 per cent to the eye, with a slight rearrangement of weights as compared with apples.

In cherries, too, the result is the same, although 20 is the weight for size as against 15 for apples, 10 for color as against 15 for apples, 20 for quality as against 15 for apples, 15 for freedom from blemishes as against 20 for apples; while form, which is included for apples, is excluded for cherries, and a new item, for "stems," is added with a weight of 15.

For items of excellence in grapes, form of bunch has 10 points, size of bunch 15, size of berry 10, color 15, quality 20, and freedom from blemishes 10. A computation shows that only one-fourth of the excellence of grapes is assigned to taste in the competitive exhibits at the Exposition.

WHY NUTS ARE BOUGHT.

NUT SCORES.—The same subordination of taste found in the judging of fruit is discovered also in the judging of nuts. The size of the nut has 15, the shape 10, thickness of shell 20, size of meat 15, quality 20 points. Although it may seem that it is positively not worth while, to say nothing of money, to buy a nut except to enjoy its delicious flavor, yet to taste is assigned only 25 per cent, while 50 per cent is given to the eye, the remaining 25 per cent going to the convenience of cracking the shells.

Somewhat different allowances are given to pecans in the scale adopted by the National Nut Growers' Association. For external character, size has 20 points, form 5, and color 5; for shell character, thinness has 10 and cracking quality 20; and for kernel character, plumpness has 20, color 5, and quality 15 points.

Upon translating these qualities, it appears that taste gets only 15 per cent of the total, while the principal attractions of the nuts go to the eye and are rated at 55 per cent, the remaining 30 per cent being assigned to qualities of convenience.

VARIED WHIMS OF THE CUSTOMER.

The common notion that, apart from the necessity of consuming food to maintain life, taste gratifications constitute the principal attractions that food offers, proves upon analysis and introspection to be

poorly founded. A wide range of fancies enter into the problem, and the farmer, or the dealer who handles his products, if he would get the best prices, must acquire some acquaintance with these fancies and not insist upon making the consumers take what he likes himself, because taste is his principal test of excellence.

From numerous illustrations of this principle in marketing, collected from many sources, the more striking ones have been selected for presentation.

DISCRIMINATIONS CONCERNING MEATS.

CERTAIN COLORS DESIRED.—The sale of corned beef, cured hams, sausage, and some salt meats of other descriptions is largely influenced by color, the popular prejudice favoring meat that has been cured and colored with the addition of saltpeter. Sausages and other forms of minced meat are also frequently colored by aniline dyes, as are the wrappers of smoked sausage and of ham. It is probable that commercial sausages of some varieties not so colored would find little sale in competition with the colored goods.

PORTERHOUSE STEAK AND NECK BEEF.—Porterhouse steak is the most expensive cut of beef, and is justly in high favor, whereas beef coming from the neck is equally nutritious and very palatable if suitably prepared, but sells for a much lower price than the former. It would be interesting to discover the reasons for this difference of demand and of price. A butchers' trade journal some time ago gave the prices for which the different parts of the beef carcass were sold, as follows: Porterhouse, 20 cents; prime rib, 15; sirloin, 12½; round, 8; rump, 7; neck piece, about 3 cents. Although epicureans admit and chemists demonstrate that the neck piece is toothsome and nutritious, it bears the lowest price. In fact, it would hardly be considered respectable to ask the butcher for a piece of the neck. Perhaps a low order of proficiency in the housewife's cooking at some time in the past, without making insinuations against the present, gave to the neck piece its low place. The story might have been different had the housewife of former times possessed the French housewife's ability to utilize meats in the making of attractive and delicious dishes.

FRESH AND "HIGH" GAME.—The epicure goes to certain high-priced hotels and restaurants, where he pays well for the birds which he says have at once that peculiar gamey flavor and tenderness which he can get nowhere else, but he rarely knows that such game has, by order of the steward, been retained in storage until it has become partially decomposed and has an odor before cooking which would prevent many people from eating it if seen and smelled in this condition.

THE INFLUENCE OF SUGGESTION, even to almost any extent of deception, is one of the most vulnerable places in the fancies of consumers. The whole fabric of the adulteration of foods rests upon this. "Sweetbreads" are eaten with a relish by people who have no idea that they

are eating the pancreas of older cattle or of the hog instead of the thymus of the calf. It is a notorious fact that consumers have boasted about the fine "lamb" they were getting, whereas the butcher knew that he had not sold them anything but kid meat; and the flavor of the "lamb" has been known to diminish in proportion to the amount of information received on this point by the consumer.

A name that has acquired a meaning in popular estimation has a stimulating effect upon the imagination of the consumer and forcibly illustrates the power of suggestion. The amount of "Canada" lamb sold in the United States is enormous. The word "Canada" has the same magical effect upon lamb prices that the word "Philadelphia" has upon spring poultry, or that of "Long Island" upon fresh eggs. These fictions seem to sell the product, and the eating public appears to feel satisfied. By tacking this word "Canada" on to his product the butcher is enabled to get 2 cents more per pound for it, or by selling at normal prices is better enabled to acquire customers who act under the delusion that they are getting something unusual for their money. In certainly 95 per cent of the cases they are getting plain domestic "lamb," and about 50 times out of 100 are not getting lamb at all, but mere mutton.

There is a strong aversion in England to "frozen" meat. Nevertheless, some of the best meat from this country is sold there as English meat, and poor grades of English meat are put on the market as American meat. In line with this is the fact that whereas, in certain places in England, American bacon would find no sale, yet, shipped as it is from this country and run into these districts as Irish bacon, it finds a ready market. Similarly, the hams sold in New England under a foreign label are usually prepared by some Western pork packer, and are considered by the consumer to be superior to the pork bearing a Western brand. The idiosyncrasies of the purchasing public are likewise appreciated by the wholesale manufacturer of sausage, who labels his product "country sausage."

Hams are imported into France from the United States through the United Kingdom and are sold to French consumers as goods of British origin, the deception being adopted to promote sale, if not to raise prices, on account of the superior fancy for English over American hams.

Yellow-skinned chickens have the preference in parts of this country as against those whose skin is more nearly white. This preference may be on account of the suggestiveness of fat beneath the skin, although, as a matter of fact, chickens store very little fat next to the skin, and then only in certain places, and certainly not on the legs; furthermore, the yellowness of the chicken's skin is inherent, and not derived from the fat beneath the skin. On the contrary, in some European countries the preference is for chickens with the lighter-colored skin.

COLOR OF EGGS, BUTTER, AND CHEESE.

Brown v. white eggs.—A curious preference, entirely unassociated with taste, is the color of eggs. Brown eggs sell for a cent or two per dozen more than white eggs in Boston, and the contrary is true in New York. Let white and brown eggs be mixed, and a dozen of them will sell for less than a dozen of either assorted, and let one or two "dirties" be visible and the price goes still lower, although, as a matter of fact, in any case the contents of the eggs are of perfect quality and can not be distinguished by taste, appearance, or nutritive value, one egg from another. Chicago is said to be undiscriminating with regard to color of egg shells, but San Francisco prefers white ones. In some markets where the brown egg is favored, as in those of England, it is said to be not uncommon to color shells of white eggs with coffee decoction or some dyestuff.

Butter and cheese are almost universally colored to meet the popular demand, and this demand varies so in different sections of this country that it is necessary for manufacturers and shippers to prepare their shipments especially for the section of country in which they are to be consumed; for instance, Washington demands a darker butter than Chicago, and New Orleans demands a color still darker than Washington.

PECULIARITIES OF HONEY BUYERS.

Honey is supposed to be a light yellow fluid, although genuine honey is often darker, and then it has a less ready sale. In some portions of the West the natural honey found is of a much heavier consistency than is ordinarily found in the East, and this condition considerably prejudices the sale of the product. Glucose with certain treatment has long been sold for honey, and when such glucose, suitably colored and made of the appropriate consistency, contains pieces of genuine honeycomb, it has been bought by many consumers with crude taste in preference to comb honey in sections.

Although prettiness goes a long way in influencing buyers, it is a singular fact that the California comb honey has been looked upon with suspicion in the East on account of its almost colorless appearance, whiteness of the wax, and the perfect filling of all cells, and honey-consuming purchasers have been known to reject this honey on the supposition that it was machine made, comb and all, so commonly accepted has been the widely circulated fiction that honeycomb is made, filled with glucose, and capped, all by machinery.

CIDER AND WINE.

Vinegar must be dark colored.—When cider was made exclusively in the old-fashioned way the apple pomace lay in the press so long that the juice received a dark red color, and vinegar made from the

cider retained this color; but in the large cider mills of the present time the expressing of the juice takes place so quickly after the making of the pomace that the cider is more nearly colorless, as also is the vinegar made from it. Apparently in recollection of the olden time, "cider vinegar," with some people, must now have a dark red color, no matter whether it is made from nearly colorless apple cider or from malt or by the chemist; and it is often the case that vinegar made from apples or apple pomace is treated with a small amount of caramel to impart the desired color, and the same is often true of distilled vinegars.

RED AND WHITE EFFECTS.—High wine is a distilled liquor that is colorless, but after it has remained for a goodly number of years in a barrel, the inside of which has been charred, it acquires the yellowish brown, or eventually reddish, appearance of common whisky. So the fancy of the tippler has been established for red liquor, and this fancy is met by the coloring of white or undercolored whisky by means of burnt sugar. Furthermore, the tippler's fancy for a beady liquor, a character honestly acquired only by age, is satisfied by dissolving glycerin in the liquor.

DECORATIVE ORANGES.

Yearly, when the ripe orange season is six weeks away in California, criticism is heard because fine yellow oranges, as good to look upon as fruit can be, as sour as lemons, and about as fit to eat as green walnuts, are shipped East. The objection is that such unpalatable fruit injures the market. The market would, indeed, be injured were the fruit sent East to be eaten, but it is not. The East buys it for table decoration, and it is well known that the oranges that can be used for table decorations are those that command fancy prices.

ADVERTISING.

Advertising, when skillfully done, is made to appeal to the fancies of consumers sometimes with astonishing success. Instances of this are found among the numerous breakfast and health foods that have become so prominent in recent years. In earlier years oatmeal was sold in this country only by druggists and was kept by them merely for the sick. Indeed, there was long a prejudice in England against oatmeal as food for human beings, though it was always a staple food in Scotland.

POLISH AND GLOSS.

WAX-LIKE APPLES.

One of the weaknesses of consumers is an admiration for foods that are polished or have a gloss, and this nickel-plate fancy plays some queer pranks with foods. The life-long resident of the large city, for instance, who has no first-handed knowledge of an apple orchard, may

buy from an apple woman at the street corner a pretty red apple with a wax-like polish on its surface secured by an application of saliva and a dirty rag. On the contrary, the apple-loving countryman, especially one who has come to be known as a "horticulturist," delights in the natural bloom of the apple.

The polishing of nuts, if they are of a kind that can be polished, is becoming more common. This may not always be solely for the gloss, but because of the beautiful color that may be developed or applied artificially, as in the case of pecans. Commercial roasted coffee is frequently glazed.

SUPERFICIAL QUALITIES OF RICE.

It is in rice, however, that is found the most conspicuous illustration of the principle under consideration. In connection with this it is pertinent to mention other elements of fancy, together constituting rice one of the more prominent products dependent upon consumers' fancies for its sale and prices. The differences in the prices of rice are determined largely by fancy, especially since, except in the South, rice is not a standard food, but more or less a luxury.

AVERSION TO SHORT GRAINS.—Two long-grained varieties of rice are produced in the United States, the Carolina and the Honduras, and one short and thick-grained variety, the Japan. The Japan variety is really the better one in nutritive value and flavor, but it sells on the market for about 1½ cents per pound less than the long-grained variety, simply because people think the long grains are the more "proper" when displayed on the table. For the same reason rice that is broken in milling sells for nearly 2 cents per pound less than the whole grains. Broken rice, unless it is so finely broken as to go through a No. 12 sieve, in which case it is known as brewers' rice, is polished the same as whole rice, and is known in Louisiana, at least, as screenings, because the whole grains (or head rice) are screened out; hence, in quality there is no difference between this broken rice and the whole grains, although broken grains do not make quite as good an appearance after cooking as the whole grains.

A widely known expert in all matters pertaining to rice, living in Louisiana, writes that "broken rice cooks just as well as the whole grains, and for family use here in the South most of the people use the broken." On the contrary, in the North broken rice so violates the fancy of the consumer for eating that it never appears on the table.

In the process of polishing, rice loses an outer coating that is nutritious and well flavored, and yet unpolished rice, with more varied nutriment and by some considered of better flavor than the polished rice, would not find ready sale to a northern housekeeper, at any rate for table purposes.

IDIOSYNCRASIES OF CONSUMERS.

With regard to vegetables, as with other foods, fancy varies from generation to generation and from one region to another. Some selections are made from numerous illustrations at hand.

A MEDLEY OF FANCIFUL NOTIONS.

The deep-yellow fleshed varieties of pumpkins are preferred and are most largely grown in the North, while in the South the lighter-colored kinds are more popular. The oval-shaped and very dark-colored eggplant is so generally preferred that the light-colored and long varieties are seldom seen. A deep red color is positively essential in rhubarb if the producer is to get profitable prices; consequently the green-stemmed sorts are rarely grown. In Berlin rhubarb is a foliage plant in the parks.

Lettuce is one of the most fickle of plants in popular fancy. Different types are popular in different parts of the country. Sometimes the markets of cities only 100 miles apart will each call for types which would be unsalable in the other. In general, the clustering and crinkled-leaved varieties are more largely preferred than the smooth-leaved and heading sorts, and green sorts are preferred to those shaded with brown, but some markets prefer the brown.

The firm-fleshed European sorts of cantaloupe are rarely seen. Americans prefer the softer although coarser-fleshed sorts. Brussels sprouts have become quite popular in the vicinity of New York, but are not largely grown elsewhere. Carrots are not so largely used in this country as in Europe for table purposes, but when so used a deep orange color is wanted.

The small rough varieties of tomatoes used in Europe for soups are not grown in this country, so it can not be entirely a fancy here that demands smoothness, solidity, flavor, deep coloring, and uniform color and size, because tomatoes are largely used as a vegetable, and yet the preference for pronounced coloring of ripe tomatoes must be ascribed largely to a fancy without corresponding taste equivalent. At any rate, the catchup manufacturers know that the sale of their goods depends upon the artificial coloring. Canned tomatoes are divided into two classes, according to their color, and it is not unusual to use aniline dye to raise the goods from the lower to the higher place.

Parsley is used quite largely for garnishing, and, as might be expected, it sells upon its appearance; the darker the color and the more curled the better.

Among the string beans those with the wax-colored pods are the most popular with many persons, because most attractive in the market and on the table. The white limas, both dwarf and tall sorts,

are the chief dependence for green-shelled beans, since most people object to colored ones. There is little choice in varieties of asparagus, the principal evidence of fancy being in the demand for blanched tips, which are more generally found in the larger markets, as in France. Asparagus before canning is usually bleached, since a white product is demanded.

Celery is popular in England in the red and giant sorts, which are rarely seen in this country, the preference here being for the dwarf and easily blanched white varieties. The ever-recurring preference for red appears again in the choice of beets for table purposes, and the varieties that are most wanted must be deep red with turnip shape.

The size, shape, and color of watermelons influence their sale to a considerable degree in some markets. Many people prefer a round, dark, solid-colored melon, while others desire one with quite different characteristics, as, for instance, the large, oblong melon with light mottled coloring.

Canned corn is frequently bleached with sulphur for the purpose of producing a light color. Cherries must be highly colored if they would sell best, except that size may counterbalance a want of color, as in the case of white oxhearts.

After prunes are classified according to size, their sale depends largely on the gloss given to them by dipping them into some substance—for instance, glycerin. They are also frequently colored by extract of logwood to please the fancy for dark-colored goods. In the sale of peaches very much depends upon color as well as upon size; and so with strawberries. Walnuts and some other varieties of nuts are bleached with sulphite to remove the yellow color and produce as light-colored an article as possible.

Different colors of glucose are demanded for different products. For some articles a perfectly colorless product is required, which is bleached for that purpose. In other cases, such as sirups, a high-colored glucose is demanded.

The color of tea is such an important matter that the practice of facing the leaves with coloring matter is not uncommon.

Cigars are made in several colors to suit the fancy of the different smokers, although frequently the only difference is in the color of the wrapper. It is a common fallacy on the part of smokers that the color of a cigar wrapper indicates its strength. Oscuro, or maduro, is popularly regarded as being very strong, and claro as mild or weak. The New England Tobacco Grower asserts that "nothing is further from the truth. Occasionally a maduro is so mild as to be insipid, and a claro so strong as to make the head swim." The practice of treating wrappers with chemicals for the purpose of imitating the spots on Sumatra wrappers has been quite common, without any change in the odor or flavor of the tobacco.

DEMAND FOR WHITENESS.

Whiteness of foods is so frequently the aim of the food producer and of the cook that some underlying cause would seem to be back of this. Perhaps it is because whiteness is so often an indication of cleanliness; at any rate, the eye is immediately to be pleased, let the source of the fancy be what it will.

LOSS OF QUALITY IN THE POTATO.

In parts of England a white potato is preferred to one with a colored skin, and concerning this Rider Haggard, in Rural England, adds that the Jersey potato, with which the English market is so liberally supplied, "is a very tasteless esculent. On the point of flavor, however, the market is careless. Among the great public of consumers the sole requisites seem to be that the potato shall be good to look at and obtainable in advance of its natural season; whether or not it is good to eat matters very little." A preference for the external whiteness of the potato does not seem to have arisen in this country, but its inside whiteness is admired at the dining table when exceptionally pure.

WHITENESS OF SUGAR.

Perfectly white beet or cane sugar is desired and, since it has been found impossible to produce this by bleaching, a small amount of some blue substance, such as ultramarine, is added to neutralize the slightly yellow tint of the crystals.

DETERIORATION OF THE OYSTER'S FLAVOR.

The demand for whiteness, to which should be added plumpness, has pursued the delicious oyster until in some markets it has lost much of its flavor. Says Forest and Stream:

> For years past there has been complaint among people who imagine that they know what oysters should be that the highly esteemed old-fashioned bivalve of good flavor has disappeared from the land and its place has been taken by a white, plump simulacrum, fair and lovely to the eye, but flat and tasteless to the palate. From this has arisen the present-day practice of drenching the oyster with vinegar, horse-radish, and tabasco sauce in the endeavor to give it some flavor.

In England the dark mantle or margin of the oyster is cut off and rejected, leaving the whiter part to be eaten.

THE CRY OF THE BREAD MAKER.

Flour made from cereals is perhaps the most conspicuous illustration of the consumers' insistence upon whiteness, and that the origin of this preference was in efforts to secure cleanliness in bread making is a suspicion, although it may have been due to the telltale dark color of bread made by the inexpert maker who allowed the dough to take too long a time in rising.

Perhaps for one or both of these reasons grew the bread maker's pride in the whiteness of her bread. Thus was enforced the housewife's demand for wheat flour that should make white bread. In arriving at this conclusion, the testimony of the chemist is not overlooked, to the effect that the whiter wheat flours make as fine and nutritious bread as any. The point is that the housewife never was a chemist, and whiteness of bread told her a tale of proper and cleanly treatment of the dough.

The Japanese like a wheat flour rich in starch, with its dextrin-forming attribute, and are not particular about the whiteness.

THREATENED EXTINCTION OF RYE BREAD.

Present memories can go back to the time when rye bread was less respectable than wheat bread in the East; indeed, there are communities now where this may be true. Perhaps price has contributed to this result. In the day when the farmer obtained his rye flour by taking his grist to a mill he rarely had wheat flour, because he did not raise wheat; he could hardly afford to buy it, as the more well-to-do people did; so respectability as well as notions of cleanliness, as associated with whiteness, began a silent warfare against the rye crop, and this, perhaps, would almost have stopped the growing of rye had it not been for whisky and the large immigration of rye-bread eaters from Europe. The delicious flavor of properly prepared home-made rye bread has not been able to withstand fully the onslaught of insubstantial fancies.

PASSING OF THE BUCKWHEAT CAKE.

In the estimation of the old lovers of buckwheat cakes buckwheat flour has suffered because of the growing demand for whiteness. Formerly buckwheat flour was slightly brown and the buckwheat flavor was unmistakable and easily detected, but more recent milling processes have made this flour much whiter, and besides this the adulterator has not neglected the opportunity to promote the whiteness by combining with the buckwheat flour some cheaper and whiter wheat or corn flour.

GINSENG.

There is a recognized fancy in China in the matter of ginseng. The southern provinces, such as Kwangtung, Kwangsi, and Fukien, take white only; whereas the central provinces, such as Kiangsu, Anhui, Hunan, and Hupeh, prefer the red; and, to satisfy the latter taste, brown instead of white sugar is used for coating the roots while they are being steamed, thereby imparting a pale, reddish tint to the product.

NEW-FASHIONED MAPLE SIRUP.

Expert tasters of maple sirup do not agree as to whether the present "improved" process of making this sirup has damaged its flavor. In the old open-kettle process of evaporating sap that had been kept long enough to ferment a little, maple sirup and sugar were of rather dark color, but the maple flavor was so pronounced that not even glucose, brown sugar, and hickory bark extract could imitate it beyond detection. With the introduction of the evaporator in present use, and in consequence of the efforts to boil the sap before fermentation, both sirup and sugar have acquired a much lighter color, and the consuming public, inexpert in the taste of maple sirup and sugar, is correspondingly pleased, so that these products, if of the old familiar color, could hardly be sold, or if so only at a much reduced price.

CORN MEAL FROM THE OLD WATER MILL.

In the older regions of the South a distinction is made between corn meal ground in a slow-going water mill and the more rapid mill operated by steam. The case is described by a Tennesseean who writes to the Scientific American:

> In grinding corn it is generally admitted that the old-fashioned water mills make better meal than the modern steam mills. These water mills, as a rule, were of small power and used a large rock or "burr" at a slow speed and ground from 3 to 10 bushels per hour. The modern steam mill, using a small burr at a high speed—even a cast burr at almost the speed of a buzz saw—puts through it about 20 bushels per hour, and the burr, mill, and all around get hot and the meal is ruined.

HALO OF OLD-TIME MEMORIES.

On the other hand, there are plenty of millers who assert that this is a mere fancy. The editor of the American Miller queries whether this distinction is not "simply an instance of that psychological process that invests the old-time memories, especially those of boyhood, with a halo that is purely subjective. The idea that the kind of power affects the quality of the meal would seem a superstition, pure and simple. The same is true as to the kind of reduction burrs. There would seem no plausible reason why a French burr or a steel roller should not make just as good meal as a native stone. No doubt just as good meal can be turned out of a steam roller mill as an old-fashioned water-power rock mill if the corn is good and fresh."

THE COLOR OF THE CORN MEAL, too, is a matter of local fancy. To a Northerner the southern fancy for white meal is misplaced, and by the Southerner the northern preference for yellow meal is similarly regarded.

LOCAL AND TEMPORAL VARIATIONS OF FANCY.

Local variations of fancy are very common, and some illustrative instances are given in the foregoing part of this article. Among numerous other geographical preferences may be mentioned the local fondness for rice along the South Atlantic and Gulf coasts and for beans cooked in a certain way in New England. Bacon has long been a familiar food in the South, but not in New England, where pickled pork took its place; but lamb and mutton, on the other hand, are not liked in the South as they are in the East. Southern markets want yellow onions, but the Northern will take red ones as well. The people of southeastern Pennsylvania, mostly those of German descent, have developed and maintained various foods rarely, if ever, found elsewhere, unless among those who have migrated from that State. Indeed, it is possible to follow the channels of migration of these people westward and southwestward by the foods that are in evidence by the way.

In Germany the preference is not for the big red apple, but for one that is green and of fine flavor and texture. The British markets want large, bright apples, preferably red; quality, flavor, and keeping character are of secondary importance.

FASHIONS IN FLOWERS.

Flowers have their fashions, and for various reasons. This is not the place for familiar stories of flower crazes, but rather to call attention to variability and peculiarity of local demands. The Easter lily had long been the favorite flower of that season in New York until 1904, when, on account of the plentifulness of these lilies and their corresponding cheapness, they came to be looked upon as too cheap for those who could buy more costly flowers, and consequently the Japanese azalea took its place.

Camellias were the choicest of all flowers in New York a quarter of a century ago, and the most expensive bouquets contained only as many of these waxy flowers as the florist charged dollars for the bouquets. These formal, artificial-looking flowers are now quite out of the trade, and gardenias, still plentifully grown in England, have only a very limited call and that from travelers from this country who have cultivated a liking for them there. A few chrysanthemums were years ago sold in autumn, but they were the hardy varieties which are grown out of doors, and no one would have dreamed that these flowers would be seen in such size and variety as now when cultivated under glass.

The violets preferred in Baltimore, Philadelphia, and Washington are the Lady Hume Campbell, with its light color, and the darker Farquhar; in New York, the Marie Louise is preferred. This is dark, like the Farquhar. Singles sell well in Philadelphia, though not in New York, Baltimore, or Washington.

LESSONS FOR THE FARMER.

Further pursuit of this subject is unnecessary to enforce the lesson that runs through the foregoing pages. Farmers should learn the whims and fancies of the markets that they reach, or can reach, and endeavor to meet those fancies. By so doing the highest prices and the largest profits may be obtained. If a farmer's products are such as go to customers who are whimsical or fanciful in their choice, and fall short of meeting such requirements, there is likely to be no profit in his operations. The farmer should not produce primarily to please himself and his own ideas of excellence; when he does so he may find a wide chasm between himself and the people whom he would like to have for customers.

City-bred people, who have little knowledge of the origin and real character of food and food products, such as the countryman has, and who have no childhood's acquaintance with the good things of the farm, are especially susceptible to suggestion; they are governed largely by appearances in their selection of farm products and are easily deceived by the trick of a false name or a false ingredient in a prepared food. Of course, the farmer is not to resort to adulteration, but from the successes of producers of adulterated goods he may learn the lesson that goes with providing honest goods that please the notions of the consumer. When a person will eat "raspberry jam" made of sweet potatoes, aniline dye, glucose or cane sugar, citric acid, and turnip seed, with some preservative, and not detect the fraud, the farmer may learn how easily responsive to appearances, and appearances alone, in food and food products a person may be who has not had a country rearing.

As was stated at the beginning of this article, farm products and their marketing are governed largely by considerations of art and psychology. It may be worth more to a vegetable leaf in the market to be frilled, or fluted, or shirred, and yet be all but destitute of power to please the nerves of taste, than to be delicious and painfully plain.

Since the farmer supplies townspeople and city people—to a growing extent people who were not reared in the country and who are lonesome if they cease to hear the clatter and roar of the city and to play a part in unnecessary bustle and crush—he must not govern himself in his business operations by standards based upon country life and country living. He must be prepared to raise pretty red apples stuffed with cotton if his customers want them; blackberries that are large and pleasing to the eye, although disagreeably sour to the taste; large strawberries, even though they may have a white tip, full of seed, and without flavor; and any other products that his own family would not care to consume because having better ones.

HONESTY THE BEST SALESMAN, AND THE HUMAN EYE A GREAT BUYER.

Some general principles appear, although more or less crude, vague, and incomprehensive. The consumer has a fondness for red, white, and the colorless, and sometimes for yellow when reenforced with large size. Gloss, polish, and luster are wanted. Things should be large and, when applicable, of plump appearance; they should be uniform in size, shapely, and with ornamental lines. A convenient and showy package is appreciated, and a product, trade, or producer's name, once established favorably, catches the fancy of customers often more easily and securely than anything else.

The gratification of the sense of taste is of minor consideration; the farmer's market customers are largely without keen discrimination in the taste of his products, in this respect being in contrast with country-bred and especially farm-bred customers, whose gustatory nerves were educated and trained in youth to be critical in the taste of the materials of foods produced on the farm.

It remains to be asserted, after all due weight and importance have been given to the fancies of consumers, that honesty is the best salesman that the farmer and dealer can have—honesty in grading, in packing, in quality, in condition.

The "honest farmer" who establishes a reputation of this sort for himself and has feasible markets within reach does not need to seek customers, because they will seek him, and he can not produce to equal the demand.

The farmer must not hang back in supplying things that are pretty to look upon, although they may not be delicious to eat; he must learn the scores of whims and notions in his available markets, even though they may be "without rhyme or reason," and remember that one of the great buyers of the products of the farm is the human eye.

THE IMPROVEMENT OF TOBACCO BY BREEDING AND SELECTION.

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INTRODUCTION.

The production of different types of tobacco adapted to the many demands of the manufacturers is one of the most important problems confronting the growers of this crop. The market grades are clearly defined and classified according to the character and quality of the manufactured product. The value of the crop depends upon the ability of the grower to produce a type conforming most nearly to the market standard for each particular grade. Of particular importance is the production of a superior grade of cigar-leaf tobacco. We are dependent to-day upon tobacco from foreign countries for most of the wrappers and fillers used in the manufacture of the better class of cigars. It has been demonstrated that there are certain well-defined areas in this country where the soil and climatic conditions are favorable to the production of types of tobacco suitable for the manufacture of the best grade of cigars. These areas will produce more profitable crops than are at present grown of this sort of tobacco, when uniform types have been developed and established by careful breeding and selection. The value of this addition to the tobacco industry lies in the fact that the money now expended for the imported article will be distributed among the American growers.

The inferiority of a large proportion of the tobacco produced in the long-established tobacco regions from native varieties may be attributed in part to deterioration of yield and quality due to lack of systematic and careful seed selection. It is a well-known fact that the proportion of the poor-grade tobacco in some of these districts is increasing, resulting in a corresponding loss to the growers.

Pennsylvania and Ohio fillers sell for 10 cents to 25 cents per pound, while imported Cuban fillers bring from 50 cents to $1.25 per pound. We can certainly produce a filler that will take the place of the ordinary to medium Cuban. An increase in yield in the native varieties due to improved methods of cultivation and fertilization involves greatly increased cost of production. Some other means of increasing the value of the crop is necessary and new types more nearly approaching the Cuban standard should be developed in order to supply the

demand of the trade for a better grade of filler tobacco. The development of such types depends upon seed selection as well as upon improved methods of cultivation and fermentation. Wrapper tobacco grown in Massachusetts and Connecticut brings from 40 cents to 80 cents per pound, while the imported Cuban and Sumatra varieties bring from $1.50 to $3 per pound, to which must be added a duty of $1.85 per pound for Sumatra, and $1.48 per pound for Cuban tobacco. To produce a wrapper leaf in the Connecticut Valley which will compare with the Cuban and Sumatra standards, new types must be developed which will more nearly approach the standard of the imported varieties and possess their desirable qualities. This can doubtless be done by careful breeding and selection. In the varieties grown for plug wrappers and fillers, the export trade and the manufacture of pipe tobacco, the development of new types is less important. In these types, however, there is need of a general improvement of the crop, more especially in yield and quality.

The many varieties of tobacco now in existence are supposed to have had a common origin, and the different types are the result of seed selection or hybridization, either accidental or intentional. The value of selection in tobacco is shown by the origin of some of the most important varieties now under cultivation. These varieties for the most part have been developed by the selection of seed from sports or striking variations, which have accidentally appeared in the established varieties. The differences which now exist among these varieties, and their marked and continuous variability, is sufficient evidence of the possibility of the production of new and improved types superior to those now under cultivation. The purpose of the selection of a variety depends on the use of the crop by the manufacturer; as, for instance, the qualities of aroma and flavor are important in filler varieties, but not so important in wrapper types. The general methods of seed selection, however, apply to all types and varieties.

Tobacco is more highly specialized and grown under a more intensive system of cultivation than any other general farm crop. It is a well-known fact that the tobacco plant is exceedingly sensitive and responds readily to soil and climatic conditions. Varieties grown in the Connecticut Valley are recognized as cigar-wrapper types, while varieties produced in Pennsylvania and Ohio are used for the most part as cigar fillers. Owing to the great influence of soil and climatic conditions and methods of culture on the yield and quality of the crop in areas adapted to tobacco growing, highly improved machinery and methods of cultivation have been developed by the growers in order to increase the profits from the crop. Instances of this tendency to adopt the most advanced methods of culture are shown by such practices as the application of $100 worth of commercial fertilizer per acre, covering the fields with slat or cheese-cloth shade, and the installation of

FIG. 1.—BELGIAN AND CRUMPLED TYPES.

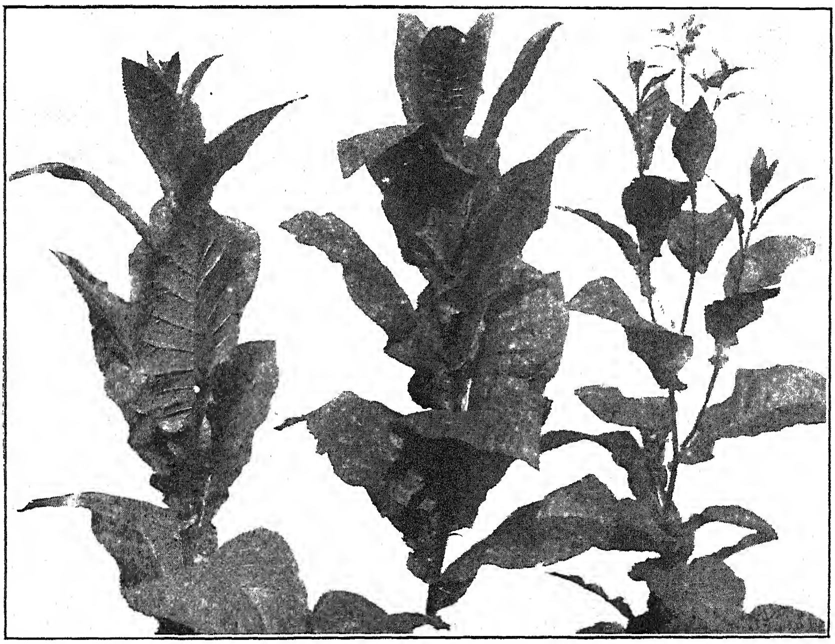


FIG. 2.—ABNORMAL, SMOOTHLEAF, AND FREAK TYPES.

VARIATION IN TYPE OF CONNECTICUT SUMATRA TOBACCO PLANTS.

extensive systems of irrigation, in some cigar-wrapper districts. This attention to certain phases of tobacco production has resulted in the partial neglect of the equally important factor of seed selection. Methods of selection have not kept pace with the improvements along other lines, and to-day are essentially the same as those used by the pioneer tobacco growers.

The suggestions which are made here for the improvement of tobacco by breeding and selection are based on the result of a careful study of cigar-wrapper varieties conducted by the writer. The experiments of the Bureau of Soils and the experience of planters in Connecticut in the growing of Sumatra wrapper tobacco demonstrated conclusively that the industry would not prove successful in that section unless new and improved types of the Connecticut Sumatra could be developed which would give a much larger proportion of leaves of uniform size, shape, and quality than the original imported seed. Experiments were accordingly undertaken by the writer in the production of such uniform types, and the results already obtained show conclusively that new types of the kind desired can be produced, and the application of the methods of seed selection and breeding developed in the course of these experiments is recommended to the growers of all classes of tobacco as a means of increasing the yield and value of their crops.

THE ADAPTATION OF TOBACCO TO SOIL AND CLIMATIC CONDITIONS.

The general principle of the necessity for the adaptation of seed to soil and climatic conditions, which is recommended by the best authorities in plant breeding, is forcibly emphasized by the experience of the writer with tobacco. In the case of cotton and corn Dr. H. J. Webber has made the observation that evidence is accumulating which shows that these crops must be bred and adapted to soil and climatic conditions, and that in order to obtain the best results growers must select their seed in the locality where the crop is regularly grown. From the fact that the tobacco plant is influenced in such a marked degree by soil and climatic conditions, this crop is a particularly striking example of the benefits to be derived from the selection of seed in districts where it is to be grown.

During the seasons of 1901 and 1902 Florida-grown Sumatra seed was introduced into the Connecticut Valley by the Bureau of Soils and grown extensively on the tobacco plantations of that region. This tobacco seed was imported into Florida from the island of Sumatra several years previous to its introduction into the Connecticut Valley and had become adapted to Florida conditions. The crops grown in the Connecticut Valley from this seed showed a lack of uniformity, which resulted in the breaking up of the variety into a number of distinct types. Illustrations of these types are shown in Plate LVIII. A small proportion of the plants in these fields held

true to the Sumatra type and produced a satisfactory yield of desirable wrapper leaves, but not more than 5 per cent of the first generation were typical Sumatra plants, and the remainder were divided into a large number of distinct, clearly defined types, most of which were radically different from the parent variety. Some of these types were apparent reversions to varieties not adapted for wrapper purposes, the leaves lacking the proper shape, body, elasticity, gloss, and other characteristics of the Sumatra tobacco. The individual plants in these types also showed great variability, and the cultivation of such a mixed and variable crop entailed a great loss to the growers on account of the small proportion of high-priced tobacco obtained and the increased cost of sorting this irregular product. The crop of 1903, grown from seed saved from that of 1902, according to the ordinary custom of tobacco planters, showed continued variability and a reproduction of the undesirable types. In 1903 typical plants of all of the different types were selected for seed purposes and the seed protected from cross-fertilization by covering the flowers with paper bags. In 1904 the plants grown from seed saved in this manner were strikingly uniform in type and closely resembled the parent plants in all characters.

One of the best illustrations of the effect of the change of soil and climatic conditions upon tobacco is the experience of the growers who used imported Cuban seed for the production of wrappers in the northern districts of the United States. The crops grown from such seed produced a large proportion of the so-called freak type of plants, which are very undesirable and bear a large sucker or branch at the axil of every leaf. The leaves of such freak plants are very small, sharply pointed, thick and heavy, and practically worthless for wrapper purposes. According to a very careful estimate this type of plant constituted at least one-third of the crop grown from freshly imported seed from Cuba. Among the types constituting the remainder of the crop were typical Cuban plants producing a desirable tobacco which was used as a substitute for Cuban-grown wrappers. This variation in type was commonly attributed by the growers to the Cuban practice of saving the seed from sucker plants. However, seed selected in the season of 1904 from the most desirable plants that could be found in Cuba, and taken from the main stalks, produced crops in the Connecticut Valley which showed only a slight improvement in uniformity of type over previous crops grown from the ordinary Cuban seed taken from suckers in the usual way. The crop in Cuba from which this especially selected seed was harvested was particularly uniform in shape and size of leaf and general type; therefore, the variation in type observed in the northern-grown Cuban plants must be attributed to the effect of the change of soil and climatic conditions. In 1903 plants grown in the Connecticut Valley from

Florida-grown Sumatra seed were grown in South Carolina with a view to producing cigar wrappers. The leaves harvested from these plants were very thick and heavy, resembling the South Carolina plug-filler type of tobacco. They possessed none of the characteristics of cigar wrappers except the shape of leaves. This change of type was doubtless due to the influence of the soil and climatic conditions in this section of the South.

It has been frequently observed that when a variety of tobacco has been grown in a particular region for a number of years it undergoes a gradual change, and produces a type peculiar to that region or locality. This condition explains the adaptability of certain sections for the production of types of tobacco supplying special market demands. In most of these crops a small proportion of plants are found which produce leaves most nearly conforming to the market standard for this class of tobacco. By saving the seed from these plants according to the methods of selection to be described later, a uniform crop of the desirable type may be secured which will be adapted to the local soil and climatic conditions.

IMPORTANCE OF GROWER SELECTING HIS OWN SEED.

The character of the soil in any region varies to such an extent that every farm presents a different set of conditions peculiar to its location. In view of the effect of a change of conditions upon the character of the plants, it is important that the grower select his tobacco seed on his own farm. After a variety has become adapted to the grower's conditions of soil and climate the yield and quality of the crop can be improved by the selection of the most desirable plants in the field for seed production. In buying seed the grower has no evidence from the seed itself as to the nature or quality of the plants which it will produce, and he is likely to lose a crop owing to the use of undesirable seed. The type of tobacco grown on the individual farm establishes a reputation in the market and determines to a considerable degree the value of the crop produced. The careful selection and improvement of the type by the grower not only increases the yield and quality of his crop, but the reputation thereby acquired insures a high price and a ready market for such tobacco.

Many tobacco growers follow the plan of saving a large amount of seed from a desirable crop, and using this seed for several years, instead of depending on the selection of seed from every crop. They entertain the idea that vitality of tobacco seed does not deteriorate with age, and that the continued growing of the same tobacco on one farm causes a deterioration in the yield and quality of the crop. Such a practice may be advisable where the farmers give no attention to seed selection or follow the ordinary method of saving seed without a careful study of the seed plants and the quality and yield of leaves

they produce. Tobacco seed is known to retain its vitality for several years if kept under the proper conditions, but it has been demonstrated that the vigor of germination is reduced and the value of the seed impaired by age, even though the circumstances of storage are very favorable. Owing to the possibility of the failure of a crop, due to unfavorable seasons or the destruction of the plants by storm or other accident, enough seed should be selected from every successful crop to produce plants for two or three seasons. The surplus seed need not be used for planting, unless the resulting crops are injured or destroyed by unfavorable circumstances, in which case this plan will prevent the loss of the type grown and selected by the farmer. The yield and quality of the crop will certainly deteriorate where the best plants are topped, where proper attention is not given to the principles of seed selection, and where the injurious effects that may follow from cross-pollination in the tobacco plant are not recognized.

VALUE OF LARGE AND HEAVY SEED.

In all samples of tobacco seed there is great variation in the size and weight of the individual seeds. Owing to their small size, making it extremely difficult to distinguish the large and heavy from the light seed except by close examination, there has been little attempt by growers to separate the different grades before sowing the seed beds, and many of the weak and undesirable plants always found in the beds may be attributed to this cause. Careful comparative tests of light and heavy seed have proved that the best developed and most vigorous plants are always produced from the large, heavy seed, while the light seed produce small, irregular, and undesirable plants. In an experiment with Cuban seed the writer separated the sample with a current of air into light, medium, and heavy grades. The germination of the heavy seed was almost perfect, while less than 5 per cent of the light seed sprouted. The plants from the heavy seed grew more rapidly than those from the light seed, and reached the proper size for transplanting from seven to nine days earlier than the plants from the light seed. Representative plants produced by each grade of seed are shown in Plate LIX, figure 1. This advantage of earliness is of special importance to tobacco growers in northern districts, where the short growing season makes it necessary for the grower to secure very early plants in order to transplant as soon as the weather will permit. The heavy seed also produced more uniform plants than the light seed, thus reducing the amount of seed-bed space needed for growing sufficient plants for the field. The growers commonly sow three or four times the area of seed bed needed in order to secure enough plants of sufficient size to set out their fields at the proper time for transplanting. If heavy seeds are used, this extra expense for seed beds can be considerably reduced, and more hardy and desirable plants secured.

The most satisfactory means of separating the light from the heavy seeds is by using a current of air. A simple and effective device for the purpose is shown in figure 57. The material necessary for constructing this machine can be obtained by tobacco growers from almost any chemical supply house. The foot bellows (*a*) is connected by means of a rubber tube (*b*) to the valve tube (*c*). The glass tube (*d*) is fitted with a rubber cork (*e*), in which the valve tube is inserted. The top of the cork is covered with a piece of finely woven gauze, in order to prevent the seeds from entering the valve tube. About an ounce of seed for separation is placed in the glass tube and a current of air is injected by means of the foot bellows. The strength of this current must be regulated by the valve (*c*), so that only the dirt, chaff, and light seed will be blown out of the top of the tube. It is advisable to screen out all of the large particles of hulls and trash before putting the seed in the tube.

An imperfect separation of the heavy from the light seed can be made by throwing the seed into a vessel of water, and allowing the heavy seed to settle to the bottom and skimming off and rejecting the light seed. This method does not make a thorough or complete separation for several reasons, one of them being the fact that the heavy seeds do not always sink, owing to the bubbles of air which adhere to them. If this plan is followed the heavy seed should be dried promptly or used for planting immediately after separation. This method of separation is recommended by Dr. L. Trabut. The conclusions on the results of his valuable experiments are as follows:[a]

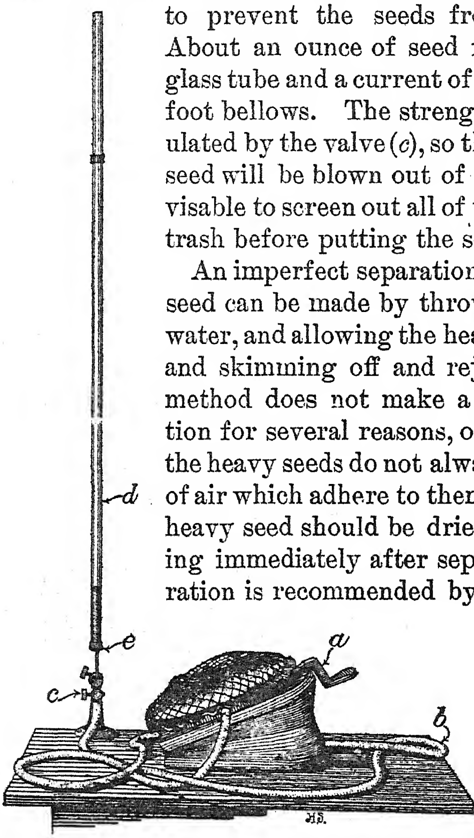


FIG. 57.—Apparatus for separating light and heavy seed of tobacco.

I observed that tobacco seed were often badly formed and had only a light density. By throwing tobacco seed into ordinary water it was observed that only half of the seed reached the bottom of the vessel. The seed which floated germinated, but gave less vigorous plants during their whole development. Seed beds were made in earthen bowls divided into two parts. In one part was sown the seed that floated, and in the other part the seed that went to the bottom. The young plants from the heavy seed were greener, more vigorous, and of larger size. All of the plants were transplanted in the same field, alternating one plant from the heavy and one plant from the light seed. All of the plants conserved their characters, but the plants from the heavy seed produced greener and wider leaves and were more vigorous. The plants from the light seed developed slowly and had a tendency to flower before sufficient development. The yield from the plants from the heavy seed was 12.5 kilograms, and the yield from the light seed was 6.4 kilograms.

[a] Bulletin No. 17. Dr. L. Trabut, Directeur du Service Botanique, Gouvernement General de l'Algerie.

If neither of the above plans is used, a less effective method of selecting the heavy seed is to use sieves with a size of mesh which will remove as large a proportion of the small and light seeds as possible.

SELECTION OF PLANTS IN THE SEED BED.

The tobacco grower has opportunity for the selection of a desirable type of plants in the seed bed at the time the young plants are transplanted to the field. From the time the young plants first appear in the seed bed until they are ready for transplanting they show great variability in type and vigor of growth. When the plants have reached the proper size for setting out in the field, the characteristic shape and comparative size of leaf may be determined by a careful study of the plants in the seed bed. At this time a definite selection of the most vigorous plants possessing the desired shape and type of leaves will improve the uniformity and increase the yield and value of the crop. The time for transplanting is a busy season for the grower, and, in order to secure enough plants to set out as great an area as possible, all the plants of the necessary size are usually pulled without much attention to the variation among the young plants. The work of pulling the plants is frequently delegated to someone without experience and incapable of making a selection of desirable plants at this early stage. The differences which distinguish the poor from the good plants are very small, and a familiarity with the variety and type of tobacco grown, combined with a close observation of the plants during their period of growth in the seed bed, is necessary in order to make a successful selection of the desirable type. In the cigar-wrapper varieties the characteristic shape of leaves of these types is clearly shown by the young plants while still in the seed bed, and as this character is of primary importance for these varieties, the value of such selection is obvious. Two types of plants selected from the same seed bed are shown in Plate LX. This selection of plants in the seed bed is supplementary to the final selection of seed plants in the field, and gives an opportunity to eliminate most of the undesirable types of plants. It may be compared in part to the roguing process in other crops, where the undesirable plants in the field are destroyed in order not to interfere with the development of the remainder of the crop. The transplanting process in tobacco makes it possible to rogue the plants before they are set out, thus saving the expense of cultivating undesirable plants.

SOME POSSIBLE IMPROVEMENTS.

The possibility of improvement in the yield and quality of the tobacco crop has been demonstrated by the results of a series of experiments in the breeding of cigar-wrapper varieties conducted by the Department of Agriculture in the Connecticut Valley. The Sumatra variety grown in this valley showed a greater amount of

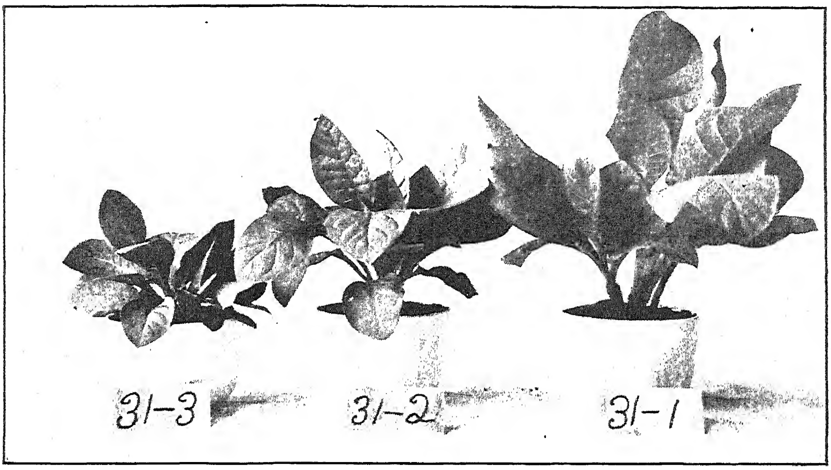


FIG. 1.—TOBACCO SEEDLINGS FROM LIGHT (31-3), MEDIUM (31-2), AND HEAVY (31-1) GRADES OF SEED.

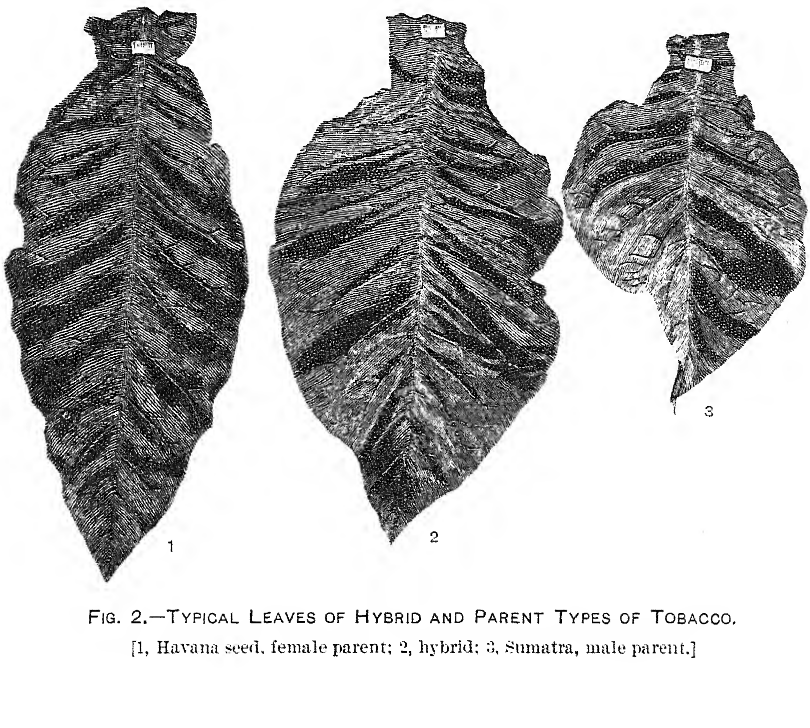


FIG. 2.—TYPICAL LEAVES OF HYBRID AND PARENT TYPES OF TOBACCO.

[1, Havana seed, female parent; 2, hybrid; 3, Sumatra, male parent.]

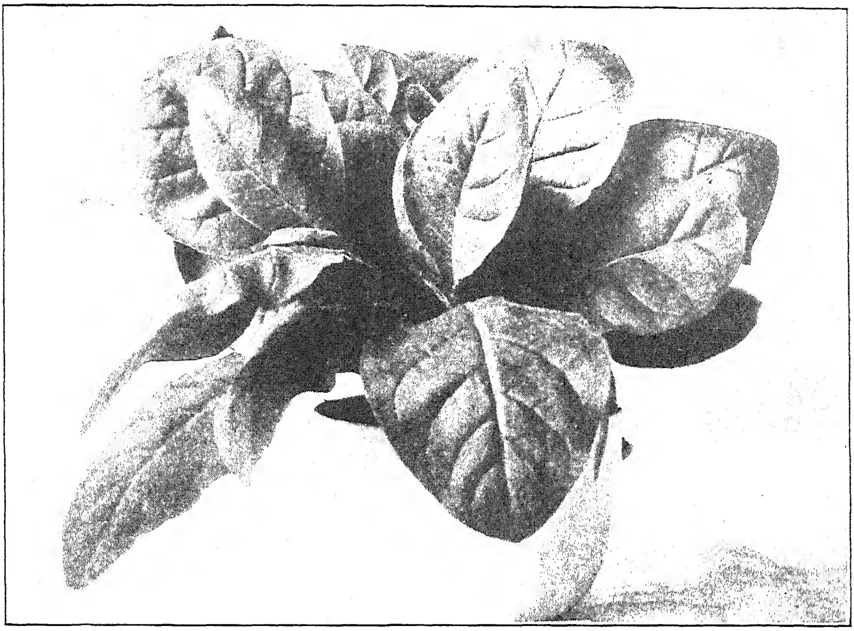


FIG. 1.—ROUNDED TYPE OF LEAVES.

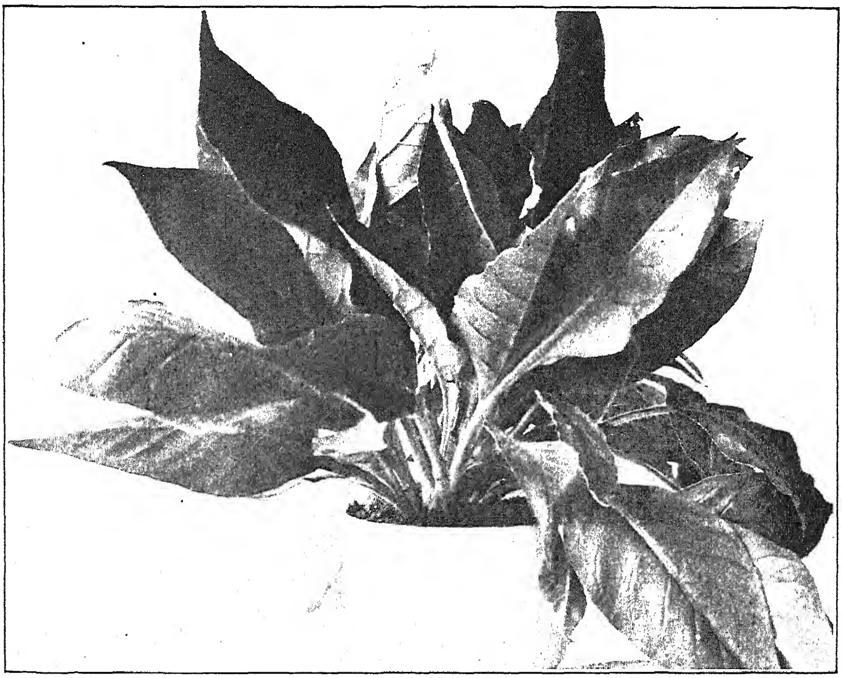


FIG. 2.—POINTED TYPE OF LEAVES.

VARIATION IN SHAPE AND TYPE OF LEAVES OF TOBACCO SEEDLINGS.

variation in type and individual plants than any of the other varieties grown for the purpose. The improvement made in the yield and value of this type is given as an illustration of the possibilities for the improvement of other varieties of tobacco. In the Sumatra variety selections were made from a representative field in which the plants showed a variation in type similar to the variation observed in all other fields of this tobacco. In this field ten separate and distinct types were observed and described, and selections of seed were made from typical plants of each. The seed was saved under bags and sowed the following season in separate sections in the seed bed, each section containing the seed from a single parent plant, and later the young plants from each section were set out in separate rows in the field. During the early stages of growth in the seed bed the distinctive characteristics of each type, particularly the shape of leaf, could be readily observed and the different types distinguished without difficulty. As the plants in the field reached maturity the particular characteristics of each parent became more clearly and strikingly apparent. In every selection in each of the ten types, the type characteristics were uniformly reproduced. In the different selections in each type slight differences were observed, representing the differences in the individual parent plants. Of the progeny from each parent every plant was uniformly of the type of the parent plant. So clearly and strikingly was this uniformity of type impressed upon the progeny of all plants selected that the most casual observer could easily note and distinguish the difference between the various types and, in most cases, pick out the progeny of the individual parents in the group of selections constituting each type. The uniformity of type in the progeny of selected seed plants is shown in Plate LXI. The grower can therefore select in the field a plant of the type he desires to grow, and by saving the seed under bag, in most cases at least, reproduce this type uniformly in the succeeding crop.

The number of leaves borne by the parent plants selected from the Connecticut Sumatra variety was found to vary from 4 to 40. This variation is illustrated in Plate LXII, figure 1. When plants with a small number of leaves were selected it was found that their progeny produced on the average about the same number of leaves as the parent; and the progeny of parents having a large number of leaves was found to produce on the average about the same large number of leaves. The increase in number of leaves was not accompanied by a corresponding increase in the height of the plants. In the case of the plants bearing few leaves the internodes were from 6 to 8 inches in length, but where a large number of leaves were produced the length of the internodes was from 2 to 3 inches. The variation in length of internodes among plants in the same type is shown in Plate LXII, figure 2. The difference in the time of ripening of the lower and upper

leaves on the plants producing a large number of leaves was no greater than where few leaves were produced. Therefore the time of ripening of the top leaves is not delayed by the increase in the number of leaves on the plant. The leaves were found to be the most uniform in size, shape, and other characteristics where a large number were borne on a single plant. It is possible, therefore, for a grower to select plants with a large number of desirable leaves and, by saving the seed from these plants under bag, to secure that increase in number of leaves in his crop. The average number of leaves in the tobacco crops of the

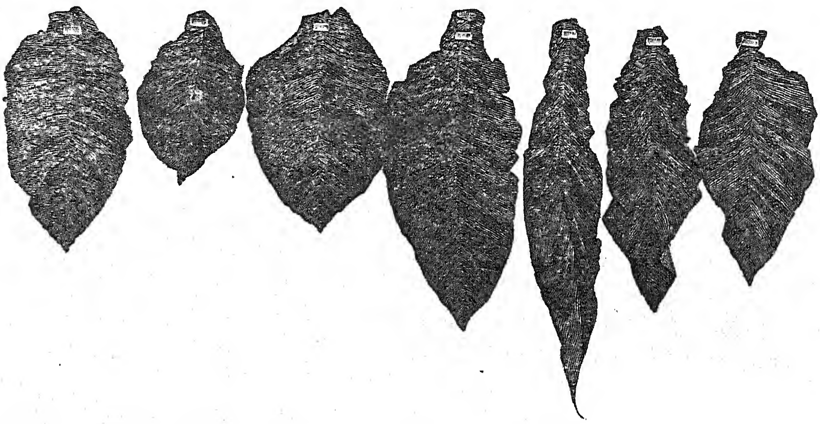
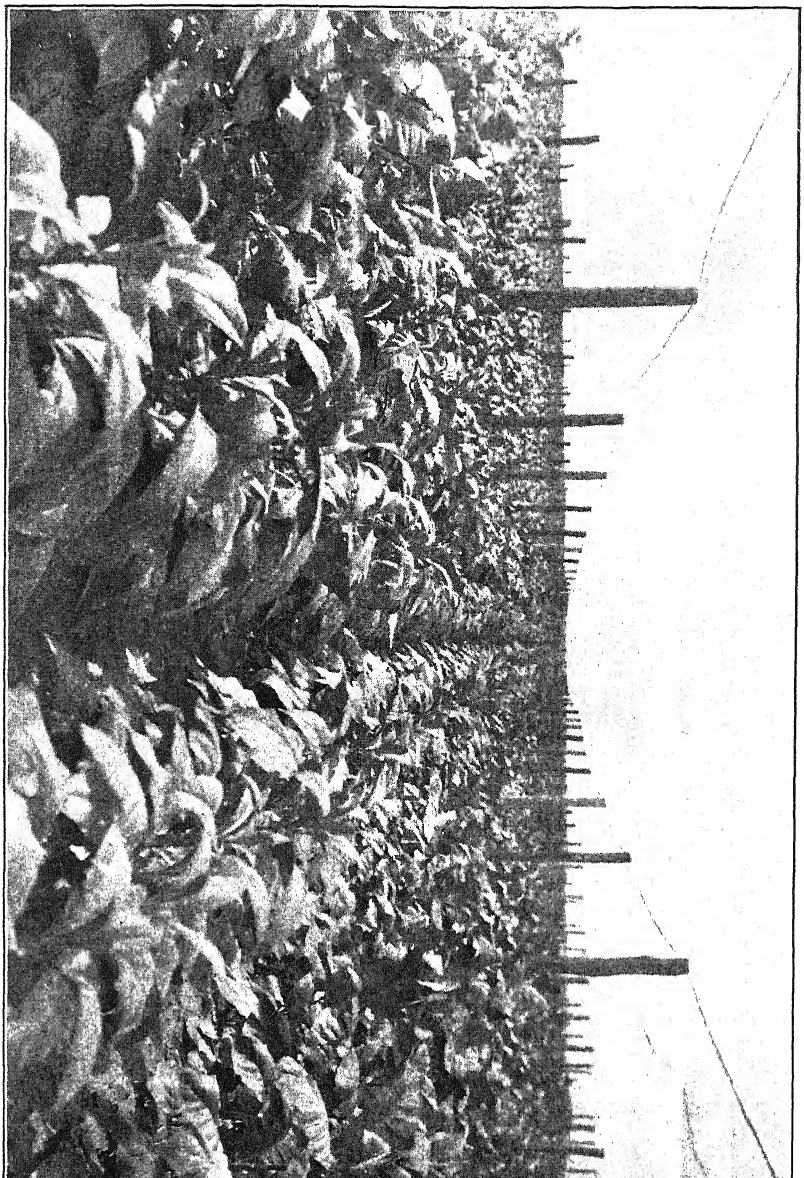


FIG. 58.—Variation in shape and size of leaves of Connecticut Sumatra tobacco.

country can doubtless be greatly increased, so that the yield will be correspondingly increased if this method of selection is carefully pursued.

In the case of selected plants having leaves with rounded tips the crop grown from the different parents invariably showed the characteristic rounded tip of leaf in all of the plants. Where the selections were made of parent plants having pointed leaves the progeny uniformly showed pointed tips. The pointed tips were almost invariably found to be associated with narrow leaves. The variation in shape of the different types of Connecticut-grown Sumatra tobacco is shown in figure 58. Pointed leaves are undesirable for wrapper purposes on account of the small number of wrappers that can be cut from them, seldom more than two wrappers from each leaf. The wide leaves with rounded tips and bases yield from four to six wrappers. The tip is usually the most desirable portion of the leaf for wrapper purposes, having the best grain and appearance, and for this additional reason a rounded tip is specially desirable. In fact, it has been conclusively proven that any shape of leaf desired, which is produced in a given locality, may be fixed and transmitted uninterruptedly to the succeeding crops by selection of the parents having the desired shape of leaf and saving the seed of such plants under bag.



UNIFORMITY OF BELGIAN TYPE OF SUMATRA TOBACCO PRODUCED FROM SEED SAVED UNDER BAG.

FIG. 1.—VARIATION IN NUMBER AND SIZE OF LEAVES PRODUCED ON SUMATRA TOBACCO PLANTS.

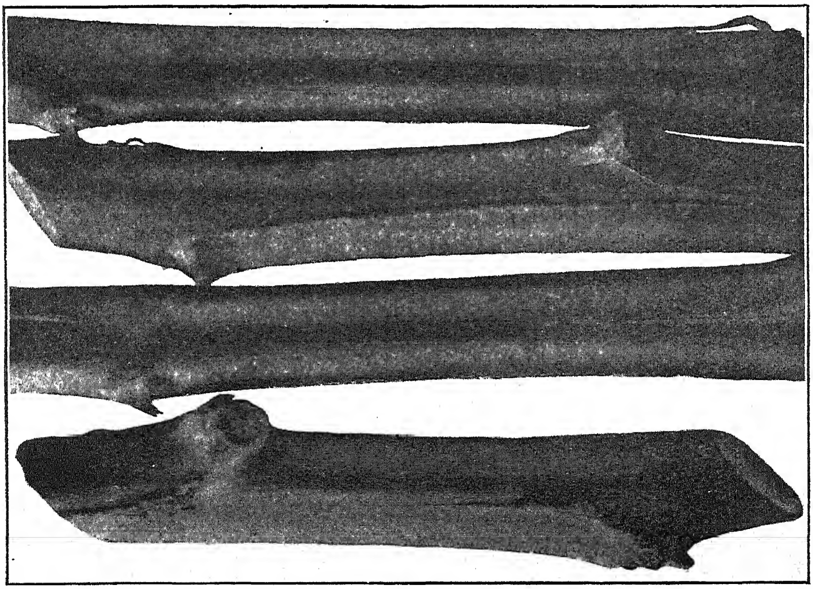


FIG. 2.—VARIATION IN LENGTH OF INTERNODES OF CONNECTICUT CUBAN TOBACCO PLANTS.

The number of suckers produced on the different plants was found to vary in the same way as the number of leaves and other characteristics. In selecting individuals free from suckers and saving the seed under bags, it was found that the crop produced from these suckerless plants produced proportionately few suckers, while the plants selected with a large number of suckers transmitted this suckering habit uniformly to all of their progeny. The grower can thus select plants free from suckers, or showing a tendency to produce fewer suckers, and by saving the seed from individual plants of this type produce strains that develop but few suckers. Seed from suckerless plants produced also the best progeny as regards the number, size, quality, and shape of leaves and other characteristics which go to make up desirable types of tobacco.

The size of leaf, it has also been found, can be controlled by the selection of seed plants having the desired size. In the selections of Connecticut Sumatra tobacco, parent seed plants were saved having leaves 35 inches long by 22 inches wide, and in the same type other selections were made of plants having leaves 15 inches long and 7 inches wide. It was found that the crop produced from these selections possessed uniformly about the same size of leaf as that selected in the parent plants. In the first case a crop was secured having an average leaf about 35 inches long by 22 inches wide, and in the second case the leaves were on an average about 15 inches long by 7 inches in width. An illustration of the difference in the size of leaves produced by two Sumatra plants is shown in Plate LXII, figure 1. In all of the selections the size of leaf of parent plants was reproduced in marked degree in the crop grown from the seed of the individual plants.

The size of leaf has an important bearing on the value of the crop in all varieties of tobacco, but more particularly in the cigar-wrapper types. Other things being equal, the greater the number of wrappers that can be cut from each leaf without waste, the greater the value of the crop to the manufacturer and the higher the price obtained by the grower. In some varieties, as the Havana seed and Broadleaf wrapper sorts, the leaf is very large and only a small portion is adapted for wrapper purposes, the remaining portion of the leaves being used for binders and fillers in low-priced cigars. In the crops of these varieties a small number of plants are found producing leaves of the proper size to better adapt them to the purposes for which this kind of tobacco is grown. The selection of seed from plants of this character is a means of controlling the size of leaves in the crop. It has been commonly supposed that the size of leaf is influenced primarily by the soil and climatic conditions. In the experiments bearing on this point the results clearly showed that the character or size of leaf was transmitted from the parent plants to their progeny with unfailing regularity, and by seed selection large and small leaved types were produced uniformly in the crop under similar soil and climatic

conditions and methods of cultivation. It is possible for the grower, then, to develop types producing leaves of the most desirable and profitable size by selecting seed from plants bearing leaves uniformly of the desired size.

In all varieties of tobacco there is considerable variation in the time of ripening of the individual plants in the field. In a tobacco crop which is harvested all at one time, the early plants remain in the field until they deteriorate in quality, while the later ones do not mature, and when harvested do not cure properly. In a similar manner the leaves on many of the plants mature irregularly, those at the top requiring from ten days to two weeks longer than the bottom leaves to reach the stage of maturity necessary before the crop can be harvested. In all of these crops some plants are found in which the leaves ripen more uniformly than in others, and by the selection of seed from such plants uniform types can be secured in which all of the leaves are ripe and ready for harvesting at one time. In 1903 a Sumatra plant was observed which ripened several days before the general crop was ready to be primed. The seed of this plant was saved under bag and the progeny set out in a separate plat the following season. The plants in this plat were ready to be harvested about two weeks earlier than the remainder of the field of the same variety. In a number of selections of plants made to secure uniformity in the time of ripening of leaves on the same individual, the progeny exhibited the characteristic uniformity of the parent plants. The crop from these plants was harvested in two primings, while the ordinary crop required three or four primings in order to secure the leaves at the desirable stage of maturity. In the varieties of tobacco in which all the crop is harvested at the same time, the uniformity in ripening reduces the expense of sorting and the loss from overripe and immature leaves, while the uniformity of ripeness in varieties which are primed materially lessens the expense of harvesting.

In improving the quality of tobacco one must be guided by the requirements of the manufacturers. In wrapper varieties the leaves must have good burning quality, texture, grain, elasticity, and strength, so as to cover well and without breaking on the cigar, present an attractive appearance, and have no disagreeable taste. The color of the leaves should be uniform in order that the grower may obtain a large percentage of high-grade wrappers and the manufacturer secure the quality of tobacco necessary for his brands of cigars without waste.

The plants bearing the largest number of leaves of uniform size and shape produce the largest proportion of leaves of uniform color. In order to determine the grade of color produced by the plants, it is necessary to compare the leaves after curing and fermentation have been completed. The shade of color of leaves on the plant in the field is correlated with the color after fermentation, light green types producing light grades and dark green shades developing the dark grades

of wrappers. The proportion of the standard grades of the best quality may be increased by taking seed from plants which develop leaves of desirable color and other characteristics. The improvement of all other varieties in the qualities for which they are produced can be carried out by the application of the general methods of seed selection.

THE METHODS OF SELECTION.

The first step in the selection of tobacco is a careful study of the individual plants in the fields from which the selections are to be made, before any plants have been topped. It is necessary for the grower to make a preliminary selection of a large number of plants at this time in order to give an opportunity for a final selection after the cured product of these plants has been carefully compared in the warehouse. The differences in quality of the product of the individual selections can be determined only by a careful study of the cured leaves. The type or general form of the plants, the number, uniformity, and shape and size of the leaves, the number of suckers, the height, and the time of ripening of the plants should be kept in mind and the plants carefully examined with regard to these points. It is of the greatest possible importance that the grower have a clear and well-defined ideal of a perfect plant best adapted to the purposes for which his crop is grown, and that the individuals selected as seed plants conform as nearly as possible to this ideal type. In a given variety of tobacco the increase in number and the improvement in shape and size of the leaves are usually correlated with a corresponding improvement in other important characteristics peculiar to the type. A large number of leaves is associated in most cases with few suckers, leaves of fine venation, elasticity, strength, and other desirable qualities.

The tobacco plant is naturally self-fertile, but is frequently cross-pollinated by insects or other agencies carrying the pollen from one plant to another. The writer has observed that under natural conditions most of the flowers on tobacco seed plants are cross-fertilized. Darwin found that self-fertilized tobacco seed produced plants superior to seed cross-fertilized within the variety, and accounted for this condition by supposing that this species is similar to the common pea and a few other exotic plants which have been self-fertilized for many generations. The variation in types and individual plants within the variety may for the most part be attributed to cross-fertilization, and uniform types and plants can only be secured by preventing this crossing. Immediately preceding the complete development of the tobacco flower, the funnel-like corolla and the stamens increase in length with great rapidity. At this time a considerable quantity of a sweetish, honey-like liquid is secreted in the base of the flower, and a number of species of insects, including the common honey bee, visit the flowers to obtain this nectar.

The anthers, which contain a large quantity of the dust-like pollen,

open below the receptive portion of the stigma. A few hours after the flowers open the stamens increase in length so that the anthers are in a position to allow a part of the pollen to fall on the stigma, and at this time fertilization takes place. The period between the time of the opening of the flower and the contact of the anthers with the stigma gives an opportunity for cross-pollination by insects or other means. The insects entering the flower at this time, after having visited other flowers in like condition, naturally brush some of the pollen from their bodies over the receptive portion of the stigma, which is in condition for pollination. Furthermore, on entering the corolla the insects are again covered by pollen from the freshly opened anthers, so that this pollen is carried from flower to flower and from plant to plant. In this way most of the flowers on the seed plants are cross-fertilized. In view of the superior value of self-fertilized seed, it is highly important that the growers use some means of protecting the seed plants from cross-fertilization. This peculiar characteristic of the tobacco plant renders the selection of seed and improvement of the variety a simple process as compared with that in the case of other crops. The grower in making the selection of seed plants need only take into account the characteristics of one parent, while in most other crops the influence of both the mother and father plants has an effect upon the character of the progeny.

SAVING SEED UNDER BAG.

A simple and effective means of protecting the tobacco flowers from the injurious effects of cross-fertilization is by covering the flower cluster with a paper bag before the flowers are ready for fertilization. This bag should be made of light but strong and durable paper, which will not injure the plant or flowers by bending the plant out of its natural position, and will not be easily torn or destroyed by rain or wind storms. The common manila bag, which can be secured at most hardware or grocery stores, is admirably adapted for this purpose. In the seed selections made by the writer in the Connecticut Valley a parchment-paper bag was used, which has the advantage of lightness and durability, and is impervious to water. The most convenient size of bag will depend upon the variety of tobacco and the size of the seed head, but in general it should be about 9 inches wide and 15 inches long. The shape of the bottom of the bag is important, from the fact that the square-bottom style does not shed water as readily as a roof-shaped bottom. A properly bagged Florida-grown Sumatra seed plant is shown in Plate LXIII, figure 2.

The center cluster of flowers in the seed head should be used for seed production, and all suckers or other seed-bearing branches should be removed before the bag is applied. The preparation of the stalk for the bag is shown by Plate LXIV, figure 2. The cluster of flowers on

FIG. 1.—PLANTS FROM DISEASED AND RESISTANT STRAINS OF SUMATRA SEED.

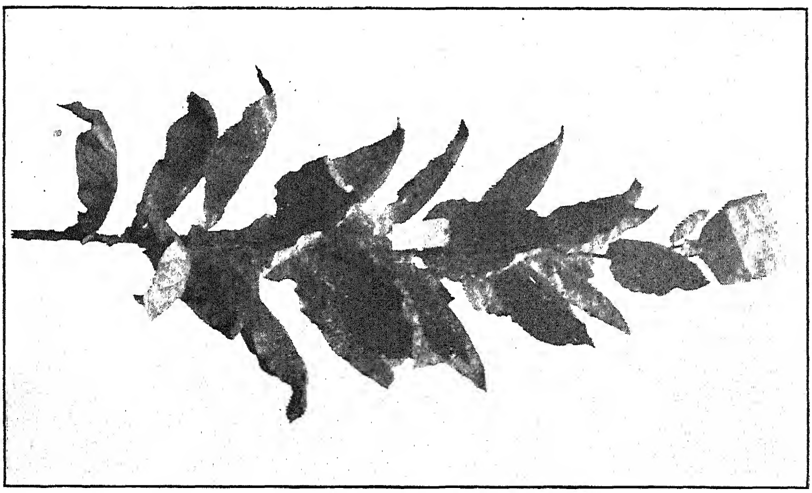


FIG. 2.—FLORIDA SUMATRA SEED PLANT, WITH BAG COVERING FLOWERS.

FIG. 1.—FLOWERS AT PROPER STAGE OF MATURITY FOR BAGGING.

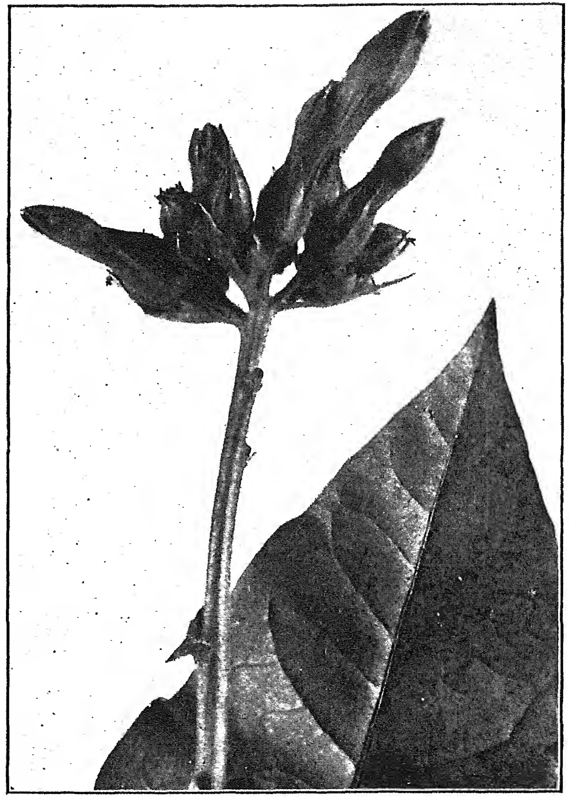


FIG. 2.—INFLORESCENCE WITH SUCKER BRANCHES AND TOP LEAVES REMOVED, READY FOR BAGGING,

INFLORESCENCE OF SUMATRA TOBACCO PLANTS.

a single plant will usually produce from 300,000 to 500,000 seeds; therefore it is unnecessary to save the inferior capsules produced by the suckers or lateral branches in order to secure sufficient seed for planting. The plants should be bagged before the earliest flowers begin to open and the bags moved up the stem every two or three days, as the plants increase in height, in order to allow sufficient space for the development of the seed head without crowding. The proper condition of flowers is shown in Plate LXIV, figure 1. When most of the capsules have begun development, indicating that fertilization has been completed, the bags may be removed temporarily and all late flowers cut off, so as not to interfere with the further development of the seed in the early and most desirable capsules; after which the bags should be replaced and allowed to remain on the plants until the seed heads are harvested. The seed saved under bag in this manner is larger, heavier, lighter in color, more free from mold, and has stronger vitality or germinating power than seed saved without bagging. After the capsules have turned brown, indicating maturity, the seed stalks should be cut and hung in a dry place where there is a free circulation of air, and allowed to remain until the seed has become thoroughly dry. The vitality of the seed can best be preserved by storing in glass jars, thoroughly dried out.

TEST OF INDIVIDUAL SEED PLANTS.

The individual tobacco plants vary in transmitting power to such an extent that it is advisable for the grower to test the selected seed plants in this respect. The object of the test is to determine the plants which most uniformly transmit the desirable characters to their progeny. In order to ascertain the prepotency of the seed plants the seed from individual plants should be saved separately and sowed in separate plots in the seed bed the following season. A careful record of the important characteristics upon which the selection of parent plants is based is a valuable aid in the study of the progeny of these plants. This record should be made in the field, as soon as the plants have reached maturity, on tags attached to the individual seed plants. The form of record varies with the type of tobacco and the purpose of selection. The outline on page 450 is a convenient form of record which has been used for cigar-wrapper varieties.

The tags bearing this record should remain attached to the seed heads until the seed is harvested. The seed from each plant should be shelled separately and kept in glass vials. Each vial should be numbered to correspond with the number of the plant from which the seed was saved. The tags should be carefully preserved as a part of the pedigree record of the plant and its progeny.

About 100 plants from each selection should be set out in a separate row in the field and each row labeled with the number of the parent plant. In the careful improvement of a variety of tobacco, it is

desirable to keep a record of the progeny of each parent plant in order to measure the advance made by breeding and selection. This record consists of notes on the development of each progeny row in the field and the yield and value of each grade of cured tobacco. The plan

Variety *Connecticut Sumatra*

Plant Number *7*

Date *August 7, 1904*

Type *Green-leaf*

LEAVES:

Number	*28*	Length	*$19\frac{1}{2}$ in*
Width	*$11\frac{3}{4}$ in*	Thickness	*Thin*
Shape	*Oval*	Color	*Deep*
Uniformity	*Good*	Rust	*None*
Spots	*None*	Gum	*Normal*
Maturity	*Early*	Position	*Erect*

Venation *Very fine*

STEM:

Height	*$8\frac{1}{2}$ feet*	Circumference	*$2\frac{3}{4}$ in*

Length of internodes *4 inches*

SUCKERS:

Number	*3*	Size	*Small*

Position *Top of plant*

SEED:

Number of pods *95*

Date of harvesting *September 19, 1904*

shown on page 451 may be taken as an illustration of such a form of record. The seed plants for the general crop should be selected from the progeny rows which produce the largest number of plants possessing the characteristics for which the parent plants were selected.

DISEASE-RESISTANT STRAINS.

The development of disease-resistant strains of tobacco will probably become one of the most important features of tobacco breeding. In the case of a root disease attacking the Sumatra variety of tobacco,

individual plants were found by the writer in 1903 which were apparently resistant to this disease. In the affected fields most of the plants succumbed and only a few produced marketable leaves. The seed from the resistant plants was saved under bag, with the object of securing a resistant type of this variety. The progeny from these plants were resistant to the disease and produced a profitable crop of tobacco, while the plants grown from other selected seed were as

Progeny notes.

Variety *Connecticut Sumatra*

Number of selection *7—1*

Date *1905*

Type *Green-leaf*

Seed.				Plants.			
Date sprouted.	Date of germination.	Per cent of germination.	Date sowed in seed bed.	Date of coming up.	Uniformity of young plants.	Date transplanted.	No. in row.
April 4.	Late.	75	April 11.	April 27.	Very good.	May 25.	100

Leaves.											
Av. No.	Av. length.	Av. width.	Av. thickness.	Venation.	Shape.	Uniformity.	Position.	Rust.	Spots.	Amt. gum.
28	20 in.	12 in.	Thin.	Very fine.	Oval.	Good.	Erect.	None.	None.	Normal.

Leaves.			Stems.			Suckers.	
Maturity.	Color.	Elasticity.	Height.	Circumference.	Length of internode.	Number.	Size.
Early.	Deep.	Good.	8 ft.	2 in.	3¾ in.	2	Very small.

Date.				Yield.
Harvest.	Cured.	Bulked.	Fermented.	Wrappers: 1. Light, 2 lbs. 2. Medium, 3 lbs. 3. Dark, 2 lbs. 4. Seconds, ½ lb. 5. Fillers, ½ lb.
1. Aug. 18. 2. Aug. 23. 3. Sept. 1.	Sept. 30.	Oct. 7.	Nov. 23.	

seriously injured as in the previous year. Plants from the resistant and semiresistant strains of seed are shown in Plate LXIII, figure 1. Similar cases of resistance have been observed in Porto Rico and other tobacco regions. This evidence, considered in connection with the production of disease-resistant strains in other crops, suggests the possibility of breeding types of tobacco resistant to many of the common tobacco diseases.

IMPROVEMENTS BY CROSSING VARIETIES.

The production of uniform types of established varieties of tobacco can only be secured by using the seed from self-fertilized plants, but new strains of varieties adapted for special purposes can be produced most readily by crossing different varieties. The production of new types of the hardy native varieties by crossing with the standard imported varieties may result in the development of new races, combining the hardiness and yield of the native with the desirable qualities of the imported tobacco. In Algeria, Dr. Louis Trabut crossed the best races of the acclimated varieties with foreign tobaccos and secured a number of types which were a great improvement over the native varieties. These new varieties, in which were united the desirable qualities of the native and foreign tobaccos, were distributed to planters and gave very satisfactory results.

The experiments of Darwin show that while crossing within a variety is detrimental, the crossing of different varieties produced seed of stronger vitality, more rapid growth of the young plants, earlier flowering of the mature plants, and a greater yield than the self-fertilized seed. He says:

> When the flowers of one variety were crossed with pollen from a somewhat different variety, which had grown under somewhat different conditions, that is, by a fresh stock, the seedlings derived from this cross exceeded in height and weight those from the self-fertilized flowers in an extraordinary degree.

Similar results have been obtained by Dr. Leonard Angeloni in a series of experiments with the crossing of a large number of Italian and foreign varieties of tobacco.

In the season of 1903 crosses were made with the native and imported varieties of cigar tobaccos. The progeny from these crosses showed a great improvement in quality, vigor of growth, and yield over the native types. The shape of leaf was materially modified, particularly in the case of the hybrids of Havana seed and Cuban, and Havana seed and Sumatra. This modification in shape and type of leaf by hybridization is illustrated in Plate LIX, figure 2. These hybrids produced very round leaves with regular and uniformly fine veins from the tip to the base. These leaves were of finer and more elastic texture than the Havana seed and better adapted for cigar-wrapper purposes. In the case of the crosses in which the Broadleaf variety was used as the mother parent, results were even more striking. The selection of seed from the desirable individual plants will, doubtless, result in the general improvement of quality and increase in yield. All other crosses showed similar results, and led to the belief that by the judicious blending of the foreign and native varieties it will be possible to produce strains possessing the desirable qualities of imported tobacco, together with the hardiness and yield of the native varieties.

THE DETERMINATION OF TIMBER VALUES.

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INTRODUCTION.

In the past it has been customary to base estimates of probable profits from the management of lands for the future production of timber in the United States upon the increase of the timber in quantity. Everyone familiar with the lumber business knows, however, that the lumber which comes out of large trees is worth more per thousand feet than that which comes from small trees, because the large trees turn out a higher proportion of the choice grades. It is apparent that estimates of profits through careful forest management should take into account this factor of quality increase; but, in the absence of an accurate determination of what this quality increase is, it has hitherto been impossible to do more than state in general terms the fact that such an increase would take place and that its effect would be to make the profit from deferred operations greater than that actually shown by the figures indicating the future yield to be expected.

DESCRIPTION OF THE EXPERIMENTS.

During the winter of 1903–4, and the following spring and summer, experiments in sawmills in different parts of the country were conducted by the Bureau of Forestry. This article will be confined to a statement of how the experiments were performed, to extracts from some of the tables and the printing in full of others, and to a brief discussion of their application.

The experiments completed so far have to do with longleaf pine in Alabama and in Louisiana, and with yellow birch, sugar maple, and beech in the Adirondacks of New York. The results here reported were obtained mainly from Adirondack hardwoods. Further experiments are now progressing in the Appalachians of West Virginia with yellow poplar, white oak, chestnut, ash, and other hardwoods typical of that region.

The main question which the experiments were to answer was: Exactly how much more valuable is a particular kind of tree of a certain size than another tree of the same kind and of smaller size? Clearly, the matter could be got at only by following the logs from trees of all diameters through the sawmill and finding out what each sawed out in amounts and grades of timber. And since the experiment was concerned not with individual logs, but with whole trees, all

the logs from each tree had to be traced in such a way that the aggregate product might be known. So men were placed in the woods who followed the saw crews, scaled each log, and marked it on the ends. Each tree was given a number and each log in that tree an additional figure, as 1, 2, etc., to indicate the first log, second log, etc. For example, 576^2 indicated the second log from tree 576. The logs were scaled according to the log rule locally used, as a check for their identification and in order to compare their contents according to the log rule with what they actually sawed out in the mill.

In the mill a man was stationed next to the slab carrier, and as each piece of siding from a marked log dropped on the live rollers this man chalked on it while it went by the number of the log from which it came. When a marked siding had passed through the edger and trimmer and had come out at the end of the mill a piece of manufactured lumber, it was graded by a competent inspector, and its log number, dimensions, and grade were tallied. By these means the contents of each log, both in grades and in quantities of lumber, were absolutely determined.

This, in brief, was the method used for all species except longleaf pine. In the case of longleaf pine the number of men available for the work was not sufficient to trace each piece of siding through the mill to see what it actually made in lumber. Instead, it was graded as it dropped from the saw and its contents were estimated.

In working up the results, the logs that had passed through the mill were first combined to form complete trees. If a log were missing, the results for all the rest of the logs from that tree had to be thrown out. An exception was made in the case of Adirondack hardwoods, when the missing log was an 8-foot top cut of just sufficient diameter to make a railroad tie and one or two boards of the inferior grades. In such cases the missing log was graded like a top log of similar dimensions and species from another tree. In no instance was this substitution used for any but small, knotty, 8-foot top logs, and then only when it could safely be done.

The trees were next divided into diameter classes varying by 1 inch, and all the lumber from each class was tallied by separate grades. The total number of feet of each grade was then divided by the number of trees tallied for that class, and the result was the average amount of lumber of that grade. Finally, the figures for each grade were rounded off by curves to reduce irregularities.

RESULTS OF EXPERIMENTS.

The results of these measurements were two tables for each species, one showing the number of feet of each grade of lumber sawed from a tree of given diameter, the second showing the money value of the lumber yielded by a single tree of each size, and the average value per

thousand feet of the lumber. The tables showing money values were made by applying to the tables of grades the average selling price of the lumber at the mill.

YELLOW BIRCH.

The following table gives the grades for yellow birch:

Graded volume of yellow birch.

Diameter breast-high.	Firsts and seconds red.	Firsts and seconds.	No. 1 common.	Shipping culls (No. 2 common).	Mill culls (No. 3 common).	Sound 7″ by 9″ by 8′ ties. (a)	Total.	Number of trees tallied.
Inches.	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*	
13	....	3	5	6	20	25	59	7
14	....	7	7	7	37	37	95	16
15	....	11	10	8	41	55	125	23
16	....	16	12	8	38	72	146	32
17	....	22	14	8	35	84	163	32
18	2	28	17	9	36	94	186	57
19	4	36	20	10	45	102	217	50
20	8	44	24	11	55	108	250	39
21	23	54	28	13	65	114	297	40
22	26	66	31	15	74	119	331	46
23	36	78	33	16	82	118	363	25
24	48	86	36	18	88	112	388	37
25	62	92	38	19	93	104	408	30
26	81	97	42	20	98	96	434	24
27	101	103	47	22	106	91	470	28
28	116	110	53	22	118	86	505	16
29	128	120	59	23	134	81	545	4
30	139	132	64	24	155	74	588	12
31	150	144	68	25	180	52	619	4

[a] To obtain number of ties divide board feet in this column by 42.

This table shows the yield of choice grades of birch advancing rapidly with the growth of the tree. The choice grades are firsts and seconds red and firsts and seconds. The amount of red birch in a tree under 18 inches in diameter is too small to consider. An 18-inch tree contained 2 board feet of this high-priced lumber, a 19-inch tree only 4 feet of it, a 20-inch tree 8 feet, but in a 21-inch tree the amount rose to 23 board feet, showing a gain of almost 200 per cent over the product of the previous diameter. The explanation for the exceptional increase is that the rules of the National Hardwood Lumber Association, under which the lumber was inspected, require red birch 4 or 5 inches wide to show one face all red; over 5 inches, one face must be not less than 75 per cent red. Red birch is heartwood, and it happens that the heartwood is not wide enough to pass the severe inspection in considerable quantities in trees under 21 inches in diameter. The increase of red birch goes on steadily from the 21-inch to the highest diameters. The next best grade, firsts and seconds, not graded by color, is contained in practically all sizes of merchantable trees. The increase of

this grade goes on steadily, but is greatest between 18-inch and 23-inch trees, because the inspection rules, which favor wide boards, show their greatest effect here. Narrow boards from small trees grade lower than wide boards from large trees.

When we compare the choice grades (firsts and seconds red, and firsts and seconds) with the common ones (No. 1 common, shipping culls, and mill culls) we find that the choice grades increase, on the whole, much more rapidly with the growth of the tree than do the latter. In the case of firsts and seconds red there was a rise between a 13-inch and a 31-inch tree from 0 to 150 feet; and in the case of firsts and seconds from 3 to 144 feet. Contrast this with No. 1 common, which rises from 5 to 68 feet; with shipping culls, which rise from 6 to 25 feet; and with mill culls, which rise from 20 to 180 feet, and the tendency of the better grades to outstrip the poor ones becomes apparent. The fact must not be overlooked, however, that a considerable amount of what would have made inferior grades went, in this instance, into railroad ties.

The following price list for hardwoods was made up after inquiry among hardwood jobbing houses in New York and Boston:

Prices of different grades of lumber from birch, maple, and beech trees.

Grade.	Price per thousand board feet.		
	Birch.	Maple.	Beech.
Firsts and seconds red	$33	....	....
Firsts and seconds	23	$20	$14
No. 1 common	14	14	10
No. 2 common (shipping culls)	8	8	7
No. 3 common (mill culls)	6	6	6

In most instances the lowest price quoted was used. The value of the railroad ties was assumed to be 40 cents for a 7 by 9 inch tie 8 feet long, equivalent to $9.52 per thousand feet—a reasonably low price.

The figures given afford a basis for calculating the value of yellow birch trees. For example, take a birch 21 inches in diameter. Turning to the table of grades we find that such a tree contains 23 feet of firsts and seconds red, worth, according to the price list, $33 per thousand; 54 feet of firsts and seconds at $23; 28 feet of No. 1 common at $14; 13 feet of shipping culls at $8; 65 feet of mill culls at $6; 114 feet of railroad ties at 40 cents per tie of 42 feet—in all, 297 feet, worth $3.97, or $13.37 per thousand feet, at the mill.

It must not be supposed, however, that as a matter of fact the exact value of a tree of a given diameter can be calculated with absolute accuracy on the basis of the figures herewith presented. The purpose of the present article is to give an indication of the rate at which the timber value of a tree increases with its diameter growth, in

consequence of the higher quality of lumber which it will yield. The number of yellow birch trees tallied for the various diameters in the above table of grades ranged from 4 to 57, and, as has already been stated, the figures of yield of the several grades given in the table do not represent the actual product sawed out, but were obtained by constructing curves to round off the inequalities shown by the actual individual averages in order to secure a nearer approximation to the general average. That the inequalities thus rounded off were in some cases considerable goes to prove that it would be unsafe to rely too closely on calculations from this table of the exact yield to be expected.

Further, the judgment of both the sawyer and the grader enters into the determination of the amount of lumber of each grade which a particular log will yield. Had the logs tallied been sawed at another mill, or even at the same mill at another time, the figures would have varied slightly. Under no circumstances is it possible to construct a table which will enable one to tell infallibly how much lumber of different grades a single tree will saw out. It is, however, possible for an owner to calculate pretty closely from the above table what he may expect to saw from a considerable body of timber of known size. From this again it is possible to construct a table of values like the following:

Value of yellow birch.

Diameter breast-high.	Graded volume.	Value per tree.	Value per 1,000 bd. ft.	Diameter breast-high.	Graded volume.	Value per tree.	Value per 1,000 bd. ft.
Inches.	*Bd. ft.*			*Inches.*	*Bd. ft.*		
13	59	$0.55	$9.32	23	363	$5.19	$14.30
14	95	.89	9.37	24	388	5.80	14.95
15	125	1.22	9.76	25	408	6.39	15.66
16	146	1.52	10.41	26	434	7.15	16.48
17	163	1.78	10.92	27	470	8.03	17.09
18	186	2.13	11.45	28	505	8.80	17.43
19	217	2.56	11.80	29	545	9.57	17.56
20	250	3.06	12.24	30	588	10.34	17.59
21	297	3.98	13.40	31	619	10.99	17.75
22	331	4.51	13.63				

SUGAR MAPLE AND BEECH COMPARED WITH YELLOW BIRCH.

Similar tables were constructed for sugar maple and for beech in the Adirondacks, and for longleaf pine in Alabama and in Louisiana. The following extract from the hardwood tables gives a comparison of the value of the lumber sawed from birch, maple, and beech of different diameters.

Value per thousand feet board measure of lumber from Adirondack hardwoods.

Diameter breast-high.	Yellow birch.	Sugar maple.	Beech.	Diameter breast-high.	Yellow birch.	Sugar maple.	Beech.
Inches.				*Inches.*			
13	$9.32	$9.75	$8.29	23	$14.30	$12.77	$9.71
14	9.37	9.83	8.70	24	14.95	12.88	9.68
15	9.76	9.93	8.94	25	15.66	12.93	....
16	10.41	10.37	8.98	26	16.48	13.07	....
17	10.92	10.71	9.10	27	17.09	13.26	....
18	11.45	11.11	9.24	28	17.43	13.58	....
19	11.80	11.47	9.33	29	17.56	....	....
20	12.24	11.84	9.45	30	17.59	....	....
21	13.40	12.30	9.52	31	17.75	....	....
22	13.63	12.57	9.61				

According to this table lumber from a 24-inch birch tree is worth $5.63 a thousand feet more than from a 13-inch tree; from a sugar maple, $3.13; and from a beech, $1.39.[a] The difference is more marked in the case of birch largely because of the presence in the high diameters of the high-priced grade, firsts and seconds red. The table for birch gives values up to 31 inches. A lumberman in cutting all sizes of birch would get, according to these figures, $8.43 per thousand feet more from his 31-inch trees than from his 13-inch trees.

The increase in value of the lumber with the growth of the tree was found to be much more rapid in the case of Adirondack birch and maple than in that of longleaf pine. The difference in value per thousand feet of the lumber from 14-inch and from 24-inch pine was $1.72, while the difference between the same diameters of birch was $5.58, and of maple $3.05. This is accounted for partly by the fact that the inspection of narrow boards is more severe with hardwoods than with pine, partly because the difference in value between poor and choice lumber is more marked in the case of birch and maple than in that of pine. The comparison is, however, not strictly a fair one, for the reason that in the experiments with longleaf pine very defective trees were rejected, while in the hardwood experiment the run of the forest at McKeever, N. Y., was taken.

PRACTICAL VALUE OF THE RESULTS.

The practical uses to which such tables might be put are apparent. With due allowance for slight changes in the character of his timber, any Adirondack lumberman could use them as a basis for figuring out, with his own price list, the values of his hardwoods. If he knows what the expenses of stumpage, logging, and manufacture amount to, he would be able to determine within close limits what trees he could cut at a profit and what trees he had better leave in the woods. In

[a] Beech over 23 inches shows a falling off in quality due to decay.

brief, he would have at hand an excellent guide to assist him in lumbering and in fixing a value on his timberlands.

Wherever surveys have been made which show the number of trees of various diameters of each species on the average acre, the tables of value could be used with peculiar effectiveness. Such surveys have been made on a number of tracts in the Adirondacks by the Bureau of Forestry. In a working plan for a tract at McKeever, N. Y., the lands were divided into six types, and the number of trees of each diameter for each species on the average acre was determined for each type. In a working plan made for a tract at St. Regis, N. Y., the number of trees of each diameter of each species on the average acre was determined for all types combined. On virgin hardwood land on the McKeever tract there were, on the average acre, of 17-inch trees, 0.80 yellow birch, 0.70 sugar maple, and 1.34 beech; of 18-inch trees there were 0.66 birch, 0.68 maple, and 0.96 beech, and so on. If all expenses of stumpage, logging, and manufacture should be as low as $10.50 on 17-inch trees there would be a profit of 42 cents per thousand feet on birch and 21 cents per thousand feet on maple. And the larger the tree cut the higher the profit. Should all birch and maple be cut down to and including 17-inch trees, there would be, with expenses at $10.50, a profit of $11.32 per acre, of which $9.82 would be from birch and $1.50 from maple. The average profit per thousand feet on all trees cut would be $4.15 from birch and $1.49 from maple.

But the profits from small trees are so slight as to make it hardly worth while removing them; certainly inadvisable if a future timber crop is to be considered. Calculating again, we find that the profits from birch and maple, if cut down to and including 18 inches, would be $11.26; cutting to 19 inches, they would be $11.06; cutting to 20 inches, they would be $10.72 per acre, etc. It will be noted that, while the smaller the cutting limit the higher the profit per acre (unless trees are taken so small as to cause an actual loss), the lower is the profit per thousand feet on the timber removed; on the other hand, the higher the cutting limit the lower is the profit per acre, but the higher the profit per thousand feet on the timber removed. Cutting birch and maple trees 17 inches and over, the profit per thousand would be $5.64; trees 18 inches and over, $6.04; trees 19 inches and over, $6.46; 20 inches and over, $6.91. "Profit per acre" and "profit per thousand feet" work in opposite directions.

Expenses vary according to distance of the timber from the means of transportation, conditions in the woods, topography, cost and quality of labor, etc. An expense of $10.50 for logging and manufacture, including stumpage, is generally considered low for hardwood lumbering in the Adirondacks, and when the expense is more than $12.75 operations are, in many cases, scarcely practicable. The profits per acre and per thousand feet in lumbering birch and maple when

expenses are \$10.50, \$10.75, \$11, \$11.25, \$11.50, \$11.75, \$12, \$12.25, \$12.50, and \$12.75 per thousand feet were calculated for the tracts mentioned above, and the results do not encourage indiscriminate cutting of hardwoods in the Adirondacks; on the contrary, they furnish the strongest possible argument against careless lumbering. Hardwood lumbering in the Adirondacks is so expensive that as a rule it does not pay to cut any but the larger trees for lumber. It is highly to the advantage of the lumberman to know just at what diameter limit his profits are turned into losses, and it is equally to the advantage of the future productive capacity of the forest that he should know this. These figures prove that the lumberman who would make the highest profits out of the Adirondack hardwoods must cut within certain diameter limits and leave, in most cases, a considerable stand of timber uncut. The argument is based not at all on what is best for the forest, but entirely on present expediency for the lumberman. It happens, however, that what is best for the lumberman turns out, in this case, to be excellent for the forest. Hardwood lumbering in the Adirondacks is not yet on a large scale, but with the growing scarcity of timber and the advancing prices of lumber there is little doubt that it soon will be. Every effort should be made to induce Adirondack lumbermen to regulate their cutting and to show them that in taking small trees they are working directly against their own interests.

THE ANNUAL LOSS OCCASIONED BY DESTRUCTIVE INSECTS IN THE UNITED STATES.

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INTRODUCTION.

In no country in the world do insects impose a heavier tax on farm products than in the United States. The losses resulting from the depredations of insects on all the plant products of the soil, both in their growing and in their stored state, together with those on live stock, exceed the entire expenditures of the National Government, including the pension roll and the maintenance of the Army and the Navy. Enormous as is the total value of all farm products in this country, it would be very much greater were it not for the work of these injurious insects. The statistics of agricultural products for the year 1889, of the Twelfth Census, and for subsequent years, gathered by the Bureau of Statistics of this Department, indicate an annual value of all the products of the farm of about $5,000,000,000. To one familiar with the work of the important insect pests of the different agricultural products entering into this total it is comparatively easy to approximate the probable shrinkage due to insects. The detailed consideration of such shrinkages which follows indicates that they will rarely fall below 10 per cent, and in years of excessive insect damage may amount to 50 per cent or even more of the important staple products of the farm. An annual shrinkage of 10 per cent is a low estimate, which is more often exceeded than fallen below, and indicates, at current farm prices, a money loss of $500,000,000—the minimum yearly tax which insects lay on the products of the farm. This total comprises, however, only losses suffered by the growing and maturing crops and annually by live stock, and does not include two very considerable and legitimate items, namely, the loss occasioned by insect pests to farm products, chiefly cereals and forage crops, in storage, and to natural forests and forest products. As shown in the consideration of these two sources of loss presented below, at least $100,000,000 must be assigned to each, making a total annual tax chargeable to insects of $700,000,000.

BASIS OF ESTIMATES.

Throughout this paper the estimate of losses in dollars is based on the farm price of the crop actually harvested, and does not, therefore, take into account the possible reduction in value which would follow the marketing of the larger crop. While it is true that prices are

regulated by production, the factor of distribution may often predominate, so that large crops in certain countries may sometimes bring good prices and small crops low prices. During the last ten years, for example, the price of wheat in this country has exhibited little if any relation to our own production. The bumper wheat crop of 1901 of nearly 750,000,000 bushels brought to the farmer 23 cents a bushel more than the crop of 1894, which was 300,000,000 bushels less, or but little more than half the production of 1901; and this year (1904) the farmer is getting nearly $1 a bushel for his wheat on a crop larger than the average.

Some definite means of estimating losses must be assumed, and any effort to scale down these losses by reckoning possible enhancement of the market price in view of the conditions just cited would come more in the category of pure guesswork and be open to quite as great objection as the plan adopted. As an offset to possibly enhanced values due to shrinkages occasioned by insects, moreover, are certain very legitimate items of cost. A very considerable item of loss properly chargeable to insects is the annual expenditure devoted to their control, which, except in the case of certain fruit and truck crops, has not been considered in the estimates. This amounts to a very considerable percentage of the value of the crop in the case of orchard fruits, truck crops, and such field crops as cotton and tobacco. In the case of the cereals, protection is chiefly secured by farm practices, such as rotation of crops, variations in the time of planting, etc., and this also applies, to some extent, to cotton, tobacco, and truck crops. In estimating the losses due to the codling moth, for illustration, it is shown that over $8,000,000 a year is expended in spraying apple trees, allowing a cost of only 5 cents per tree. In the case of citrus fruits the cost of gassing and spraying ranges from 5 cents to $1.50 per tree.

Another legitimate class of losses not included in the estimate is the secondary losses which necessarily result from diminished products. For example, the excessive reduction in winter wheat through the Hessian fly ravages in 1900 put a serious check upon milling operations throughout the region worst affected and caused very heavy loss in this field of industry. Similarly a shortage of cotton may so increase the values as to lead to the shutting down of cotton mills, as has been illustrated recently. A shortage of grains means a corresponding loss to the railroads and other transportation companies and to shippers. In other words, any material shrinkage in an important product starts a train of losses to the end of the chapter, the total amount of which is quite beyond calculation or estimate.

The writer believes that these omitted items of loss will make good any difference of price which might result from the larger crops if insect damage were entirely eliminated. Outside of the cash value of

the crop, furthermore, is the actual material loss in products, which is absolute so far as the consumer is concerned. The importance of this loss will vary with the nature of the crop. With perishable products, such as fresh fruits and vegetables, the losses due to insects may be of minor importance. For example, if the apple crop were increased by 25 or 50 per cent of marketable fruit, values would probably shrink a corresponding amount, and the demands of consumption and the possibilities of storage be very greatly exceeded, so that there would actually be very little benefit, if any, to the producer. On the other hand, in the case of staple products of long keeping quality, as grains, cotton, sugar, lumber products, etc., the loss may be reckoned as more nearly complete, and the chief loss due to insects falls in this latter class.

RESULTS OF CONTROL OF INSECTS.

Enormous as is the annual loss which may now be fairly charged to insects, it would undoubtedly be vastly greater if such pests were left absolutely unchecked and no efforts were made to limit their operations. Were it not for the methods of controlling insect pests, resulting from the studies of the Bureau of Entomology and of the official entomologists of the various States, and the practice of these measures by progressive farmers and fruit-growers, the losses from insects would be greatly increased. Familiar illustrations of savings from insect losses will occur to anyone familiar with the work in economic or applied entomology in this country. The cotton worm, before it was studied and the method of controlling it by the use of arsenicals was made common knowledge, levied in bad years a tax of $30,000,000 on the cotton crop. The prevention of loss from the Hessian fly, due to the knowledge of proper seasons for planting wheat, and other direct and cultural methods, results in the saving of wheat to the farm value of from $100,000,000 to $200,000,000 annually. Careful statistics show that the damage from the codling moth to the apple is limited two-thirds by the adoption of the arsenical sprays, banding, and other methods of control, representing a saving of from $15,000,000 to $20,000,000 in the value of this fruit product alone. The existence and progress of the citrus industry of California were made possible by the introduction from Australia of a natural enemy of the white scale, an insect pest which was rapidly destroying the orange and lemon orchards, this introduction representing a saving to the people of that State of many million dollars every year. The rotation of corn with oats or other crops saves the corn crop from the attacks of the root worm to the extent of perhaps $100,000,000 annually in the chief corn-producing regions of the Mississippi Valley. The cultural system of controlling the boll weevil is already saving the farmers of Texas many millions of dollars, and, in fact, making the continuance of cotton growing possible; and scores of similar illustrations could be cited.

The losses occasioned by insects to farm products exhibit a wide range in different years, due, as a rule, to favorable or unfavorable climatic conditions, and also to the abundance, from time to time, of natural enemies. The result is more or less periodicity in the occurrence of bad insect years. In other words, periods of unusual abundance of particular insect pests are, as a rule, followed by a number of years of comparative scarcity. Furthermore, seasons which may be favorable to one insect may prove unfavorable to others, hence there may be not only periodicity in the occurrence of the same insect, but more or less of a rotation of the different insect pests of particular crops.

THE VALUES OF FARM PRODUCTS AND LOSSES CHARGEABLE TO INSECT PESTS.

In the table following, the value of certain farm products, namely, the cereals, hay, cotton, and tobacco, is based on the reports of the Bureau of Statistics of this Department for 1904. The other values are taken from the census figures of 1900. The values assigned to farm products are given in round numbers for convenience in citation, and allied products are thrown together to get a more compact and readily understood statement. The last two columns, indicating the shrinkage due to insect work, are based on the crop actually harvested—that is to say, except for such damage the crop would have been 10 or 20 per cent greater. It will be noted also that the total value of farm products is greater than that given in the opening paragraphs of this article. This is accounted for by the fact that for the purposes of this table, indicating insect damage, no subtractions are necessary to represent the farm products consumed by live stock, inasmuch as the damage due to insects is to the growing and maturing crop, and the losses indicated for the crops and for animal products are independent.

Annual values of farm products and losses chargeable to insect pests.

Product.	Value.	Percentage of loss.	Amount of loss.
Cereals	$2,000,000,000	10	$200,000,000
Hay	530,000,000	10	53,000,000
Cotton	600,000,000	10	60,000,000
Tobacco	53,000,000	10	5,300,000
Truck crops	265,000,000	20	53,000,000
Sugars	50,000,000	10	5,000,000
Fruits	135,000,000	20	27,000,000
Farm forests	110,000,000	10	11,000,000
Miscellaneous crops	58,000,000	10	5,800,000
Animal products	1,750,000,000	10	175,000,000
Total	5,551,000,000		595,100,000
Natural forests and forest products			100,000,000
Products in storage			100,000,000
Grand total			795,100,000

INSECT DAMAGE TO CEREAL CROPS.

Only the losses to the two more important cereals, corn and wheat, will be discussed in this paper, as the injury to oats, barley, rye, etc., will average about the same percentage and need not be specifically analyzed.

INSECT DAMAGE TO CORN.

In point of quantity and value corn is the leading cereal crop of the United States. Its annual farm value in later years has nearly equaled and sometimes exceeded $1,000,000,000. While less subject to insect damage than wheat, the next most important cereal, the corn product would be considerably greater were it not for important insect pests. The work of several of these is obscure, and many farmers are entirely ignorant of the existence even of some of the worst enemies of this crop. In this last category falls the work of the corn root worm (*Diabrotica longicornis*), which ordinarily passes unnoticed, or at least is often misunderstood. The larva of this insect feeds on the roots of young corn, and in regions of bad attack may cause an almost entire loss of the stand. The corn root worm, together with one or two allied species working in substantially the same way, causes an annual loss of at least 2 per cent of the crop, or some $20,000,000.

Perhaps the next most important insect pest of this cereal is the boll worm or ear worm. This insect, as shown by Mr. A. L. Quaintance, special field agent of this Bureau, probably attacks from 90 to 100 per cent of the ears of sweet corn throughout the country, and in the South practically an equal percentage of the ears of field corn, as shown by actual counts in the field made during the years 1902 and 1903. The average loss in the number of kernels to an attacked ear is 15 per cent, or, if allowance be made for the smaller size of the terminal kernels, at least a loss of 7½ per cent. The percentage of loss is less in the great corn areas of the Northern and Middle States, but a 2 per cent loss for the United States chargeable to this insect is certainly well within the limits of actual damage, and would, for the corn crop of 1904, indicate a loss of over $20,000,000.

Of perhaps equal importance to this crop are the depredations of the chinch bug. Chinch bug injury is, as a rule, more marked where corn is grown in the neighborhood of wheat or other small grains, and in such cases the migration of the chinch bug from wheat to corn may often result in the total destruction of considerable areas of corn. The chinch bug is a strong flier also, and at the period of migration in midsummer corn is often attacked, the loss in the case of this cereal being, however, very much less than in the case of wheat. For the country as a whole, however, the loss from the chinch bug, taking one

year with another, will probably be 2 per cent of the crop, or, estimating from the crop of 1904, $20,000,000.

Every year in different sections of the country there is notable injury to corn by such insects as bill-bugs, the various wireworms, cutworms, and army worms, stalk-borers, various species of locusts or grasshoppers, corn plant-lice, and other insects, to a total of fifty fairly important species. These minor pests undoubtedly cause a loss of an additional 2 per cent, making a total annual injury of 8 per cent, and indicating a loss of $80,000,000.

INSECT DAMAGE TO WHEAT.

Of the cereal crops of this country wheat suffers most from insect depredations. Of the large number of insects which depredate on this cereal, the three important species are the Hessian fly, the chinch bug, and the grain plant-louse, using the latter term to include several allied species which work in much the same manner. The chinch bug is notably a wheat pest, although its damage to other cereals and forage crops is very considerable. The losses from the depredations of this insect on wheat in single States have ranged between $10,000,000 and $20,000,000 in one year. A very reasonable average annual estimate of loss, taking the country as a whole, would be 5 per cent of the value of the wheat crop, which would indicate about $20,000,000 a year chargeable to this insect.

The Hessian fly is distinctly a wheat pest, although doing some damage also to rye and barley. The losses due to this insect will be considered more in detail to indicate their nature specifically and to illustrate the exactness and reliability which may sometimes characterize records of this kind relating to particular pests of a single crop.

The season of 1900 is notable in Hessian-fly annals as exhibiting the most destructive work of this pest in recent years. The fly was very generally present throughout the main wheat-growing districts of the Ohio and Mississippi valleys, but its ravages were this year concentrated particularly in Ohio and Indiana. The statistics of the acreage and yield of wheat and value of the crop for this year for the States mentioned reflect very plainly the loss occasioned by this pest. The wheat area in these two States in 1900 and the years immediately preceding was about 5,000,000 acres. Chiefly on account of the ravages of the Hessian fly more than half of this acreage (2,577,000 acres) had been abandoned and planted to other crops prior to May 1, 1900, as shown by the records collected by the Bureau of Statistics of this Department. The abandonment was about 40 per cent for Ohio and 60 per cent for Indiana. The cost of the preparation of soil, planting, and seed wheat for this abandoned acreage is all that need be reckoned, inasmuch as it was possible to use the land for other crops, such as corn or oats. The loss in labor and material indicated will approximate

$3.50 per acre, giving a total of over $9,000,000. Of the remaining wheat acreage, the average yield per acre for this year in Ohio was 6 bushels as against 15.3 bushels for the year following, 14.2 bushels for the year previous, and nearly 17 bushels for the years 1897 and 1898. For Indiana, the yield per acre in 1900 was only 5.3 bushels as contrasted with 15.8 bushels for 1901, and 15.6 and 9.8 bushels, respectively, for 1898 and 1899. In other words, a decrease in the yield per acre is shown of nearly two-thirds, for these two States, for the area in wheat which was left for harvesting. The Hessian fly does more or less damage every year, which reduces the average yield per acre, and, therefore, if such damage be eliminated, the average yield per acre should be in the neighborhood of 15 bushels, indicating a loss for this year from the Hessian fly of nearly 10 bushels per acre for the area harvested, or, for the two States, of 24,230,000 bushels of wheat, of approximately a farm value (at the low price for that year) of $15,000,000. This loss, combined with the $9,000,000 indicated for the abandoned acreage, gives a total direct loss for these two States of over $24,000,000. These figures, enormous as they are, are based on the careful statistical records of the acreage, yield, and prices of 1900 collected by the Statistician of the Department, working entirely independently of the Bureau of Entomology.

During this year the damage in other wheat-producing States was notable. For example, more than 20 per cent of the planted area of Michigan was abandoned, and lesser amounts in other States, with great shrinkages in the yield of acreage which was actually harvested. The loss, therefore, for this single season, due to the Hessian fly, undoubtedly approached $100,000,000.

The losses occasioned by this insect, while showing great fluctuation, as indicated above, are an annual tax on the wheat crop. Except in cases of exceptional severity they pass, however, comparatively unnoticed. For example, the Hessian fly is not being especially complained of this year (1904), yet the agent investigating the insect enemies of cereal crops in the Ohio valley reports that many fields show injury to the extent of from 50 to 75 per cent. In comparatively few years does this insect cause a loss less than 10 per cent of the crop, or the equivalent of a shrinkage of over 50,000,000 bushels in the yield, or, on the valuation of the crop for 1904, of over $40,000,000.

The losses due to wheat plant-lice are often very considerable, resulting in a heavy shrinkage of wheat at the moment of maturity, when the wheat heads may be covered with these lice, sucking away at the soft, forming kernels. The yield of badly infested fields may be reduced at this time from 25 to 50 per cent, and when weather conditions are favorable this pest is often abundant over enormous areas.

The annual loss occasioned by wheat plant-lice probably does not fall short of 2 or 3 per cent of the crop.

The many other insects depredating on wheat, including grasshoppers, the wheat midge, several species of sawflies, and the cutworms and army worms, will swell the total of loss to at least 20 per cent of the crop. In other words, were it not for the attack of these pests the wheat crop would be one-fifth greater than it now is, or have an additional value of approximately $100,000,000.

The insect damage to other cereal crops probably falls short of 10 per cent. A 10 per cent average, however, for all the cereals, is certainly a reasonable one and is the basis of the loss indicated in the general table.

INSECT DAMAGE TO HAY AND FORAGE CROPS.

The damage by destructive insects to hay and forage crops is more obscure and less generally understood than in the case of any other farm products. Certain of the larger insects depredating on hay and forage crops are commonly known. These include the various species of locusts or grasshoppers, army worms, and cutworms. Very little understood and generally overlooked, however, are the webworms and small grass worms (*Crambus* spp.) which work about the base or roots of the plants, and which are so abundant that at the proper season the moths flit up in front of one at every step. Swarming also in grass lands are many species of minute leaf-hoppers which reduce the yield enormously, their small size being more than offset by their prevalence and numbers. Obscure, but very important also, are the white grubs, which work on the roots and often kill the grass outright over large areas, and everywhere tax production considerably. In the same class in habit are the meadow worms or leather jackets, the grass-root feeding larvæ of the crane flies. A 10 per cent shrinkage from these and other pests in grasses and forage plants is a minimum estimate.

INSECT DAMAGE TO COTTON.

The principal insect depredators on cotton are the cotton boll weevil, the bollworm, and the leaf worm. Many other insects, however, inflict minor damage. The loss chargeable to the boll weevil, from the very conservative estimate of Mr. W. D. Hunter, the agent charged with the study of this insect in Texas, represents, for the year 1904, some $20,000,000.

The bollworm is chiefly destructive in the southwestern cotton-producing States of Mississippi, Indian Territory, Oklahoma, Arkansas, Louisiana, and Texas, and causes a damage in these States of from 2 to 60 per cent of the crop. East of these States comparatively little damage is done by this insect. The damage for the States first

mentioned, where this insect is most injurious, has been very conservatively estimated by Mr. A. L. Quaintance at 4 per cent of the crop of these States, and indicates an annual loss of some $12,000,000.

The cotton leaf worm in years of excessive damage, before the use of arsenical poisoning was a common practice, caused a loss of $20,000,000 to $30,000,000. The present damage resulting from this pest is very much reduced, but with the increased acreage of cotton an annual loss of from $5,000,000 to $10,000,000 may be conservatively estimated. Without counting the losses due to many minor insect depredators, we have already a total loss of more than $40,000,000 chargeable to three important insect pests of this staple.

INSECT DAMAGE TO TOBACCO, TRUCK CROPS, SUGAR CANE, ETC.

Detailed statements relative to the insect losses to the crops enumerated above will not be attempted in the space at command. All of these crops are subject to the attacks of important insect pests, and a reasonable estimate of the annual damage is 10 per cent of the value of the first and last named crops, and fully 20 per cent in the case of truck crops. Vegetables and other truck crops are especially subject to insect injury, and, furthermore, in the case of these crops there is always a large expenditure in the control of insects, the items of actual damage and cost of control together probably making the tax due to insects double the normal 10 per cent rate.

INSECT DAMAGE TO FRUITS.

The orchard and small fruits suffer heavily from insect pests, both directly and because of the expensive methods of treatment necessary to prevent still greater losses. The examination of this subject will be limited to the insect injuries to the apple. There are several hundred insects which depredate on the roots, trunk, foliage, and fruit of the apple. The important pests are the woolly aphis, injuring the roots; the trunk and limb borers; the leaf worms, canker worms, and tent caterpillars; and the various scale insect pests, including the San Jose scale. Injuring the fruit are the codling moth, the curculio, and the apple maggot. It is a very difficult matter to estimate the amount of loss chargeable to these various insects. Those affecting the health and vigor of the tree itself lessen the productiveness at least 17 per cent, estimating 5 per cent for the woolly aphis, 2 per cent for borers, and 10 per cent for the plant-lice, scale insects, and caterpillars and other leaf depredators.

Very notable injury to the fruit also results from the work of the curculio and the apple maggot, but space will be taken merely to discuss somewhat in detail the injury chargeable to the codling moth. This species probably causes a greater monetary loss than any of the other enemies to fruits. Various estimates of the loss due to its attacks

have been made, and in general it is believed that roughly it causes a loss of from one-fourth to one-half of the apple crop of the United States every year. Mr. C. B. Simpson, while special field agent of this Bureau, gave some of the recent estimates of losses in various States:

In 1889 Professor Forbes reached the conclusion that the annual loss in the State of Illinois was $2,375,000. It is estimated that in 1892 the insect caused $2,000,000 loss to Nebraska apple growers. Professor Slingerland estimates that in 1897 the insect taxed the apple growers of New York $2,500,000. In 1900 one-half of the crop of Idaho was damaged, while in 1901 the loss was much greater. Mr. McPherson estimates that in Idaho the loss in 1902 was $250,000. * * * In many sections of the Pacific Northwest the loss was from 50 to 75 per cent.

An estimate made by Mr. Simpson and the writer[a] is perhaps as nearly accurate as may be in indicating the quantity lost in barrels of merchantable apples. The best available estimates of the apple crop of the United States are those compiled by the American Agriculturist, and from these it is found that the average crop for the five years from 1898 to 1902 was 47,000,000 barrels. This includes only apples of first and second quality.

It has been shown by careful observations in various apple-growing States that the codling moth, as already indicated, may cause a loss of from 20 to 40 per cent of fruit which would otherwise be sound and merchantable. For reasons to be given later on, in computing the actual monetary loss to the apple growers of this country by the codling moth, we prefer to take the lower of these two estimates. This 20 per cent decrease in merchantable apples would represent some 12,000,000 barrels, and at an average profit of $1 per barrel indicates a loss of $12,000,000, less the value of this fruit for cider purposes, supposing that it is all so used. The average price for cider apples will not exceed 30 cents per barrel, which would represent a reduction of $3,600,000, leaving a net loss of $8,400,000. The loss throughout the country in small orchards supplying local needs undoubtedly averages much higher than in the large commercial orchards, which supply the bulk of the fruit to the markets. The estimate made by Mr. Simpson of the loss in such home orchards is $3,000,000, which, added to our former figures, gives a total direct loss to the apple crop annually from the codling moth of $11,400,000.

One would be perfectly justified in estimating the actual loss in merchantable apples at a much higher figure than 25 per cent, and an average might be assigned of 35 or 40 per cent at least, which would have very greatly increased the apparent monetary loss. There are, however, considerations which offset the monetary loss occasioned by the codling moth and undoubtedly reduce it very considerably. The apple is a perishable fruit and must be consumed within a limited

[a] Bulletin No. 41, Division of Entomology, The Codling Moth.

period. It is not like wheat and other cereals, the standard grades of which have fairly fixed values and which may be kept indefinitely. The cold-storage system has very much extended the marketing period of apples, but this affects only a limited amount, measured by the actual cold-storage capacity, and the bulk of the crop must find an immediate market. Therefore, if the additional fruit which is now rendered unsalable by the codling moth should be thrown on the market, the actual price of apples would probably be affected even more than the increased supply would indicate. The increase in our export apple trade, which is being actively encouraged by the Department of Agriculture, and the development of cold-storage facilities for fruit will undoubtedly increase the market for apples from year to year. Nevertheless, one is warranted in taking the lower estimates considered above, in view of the probable decrease in prices which would result if the codling moth damage did not materially reduce the crop every year.

An additional and important item of loss is the annual charge for spraying or otherwise treating apple trees, without which, as indicated above, the losses from the codling moth and curculio would be doubled if not trebled. Practically all commercial apple orchards are sprayed annually with arsenicals, and banding of trees and other means of protection are also practiced. Of the 200,000,000 apple trees enumerated in the last census, on the authority of Mr. Taylor, at least 165,000,000 are in bearing condition, and the cost of spraying and other treatments for these will range between 5 and 10 cents per tree. As an offset to untreated orchards, the lower estimate of cost may be taken, namely, 5 cents per tree, which gives a charge for treatment of $8,250,000. Combining the direct shrinkage or loss and the cost of protection from still greater loss gives a total tax chargeable to the codling moth of nearly $20,000,000.

The insect losses to other deciduous fruits are quite as heavy as in the case of the apple, and especially when the treatments for the San Jose scale and other scale pests are considered; and in the case of citrus fruits the cost of treatment is much greater and the actual losses again heavy. We are warranted, therefore, in placing the loss to fruits from insect pests as high as 20 per cent annually.

INSECT DAMAGE TO FORESTS.

The valuation of farm forests, namely, planted forests of artificially wooded areas on farms, is given in the last census at $110,000,000. A brief consideration of the numerous insect pests of such plantings, including the borers—which often almost utterly destroy the trees, as in the case of the black locust—the leaf defoliators, and many other varieties of depredating insects, indicates that a 10 per cent annual loss of such plantings is not an unreasonable estimate.

Of very much greater significance and economic importance, however, is the insect loss to natural forests and to wood, lumber, and manufactures. The annual losses occasioned by insect pests to such forests and forest products have been estimated by Dr. A. D. Hopkins, special agent in charge of forest insect investigations, at not less than $100,000,000. This is based on late stumpage values and on the wholesale prices of the commercial products; in other words, it covers both the losses from insect damage to standing timber and to the crude and manufactured forest products. The annual loss to growing timber is conservatively placed at $70,000,000. This represents a loss of $20,000,000 annually to hardwood timber, as indicated by Doctor Hopkins in his article in the Yearbook of this Department for 1903, and $50,000,000 annual loss to coniferous forests. As a single illustration of the loss in the last category may be mentioned the destruction in the year 1902 of 600,000,000 feet of valuable timber in the Black Hills district, representing a cash loss of upward of $25,000,000 in one limited area. The damage by insects working in lumber and manufactures of wood is very considerable, and has recently been estimated by Doctor Hopkins to represent a minimum annual loss of 5 per cent of the valuation of such products, amounting to some $30,000,000 and completing the total of $100,000,000 already indicated. This loss is in addition to the loss to farm forests referred to.

INSECT DAMAGE TO MISCELLANEOUS CROPS.

A great many minor crops enumerated in the census of 1900 can not be discussed separately, and the valuation of these crops is lumped together and a 10 per cent loss chargeable to insects estimated on the whole, which seems reasonable in view of the examinations already made of the more important farm products.

INSECT DAMAGE TO CATTLE.

The losses due to biting and parasitic insects of cattle are considerable. The principal culprits are the ox warble and various biting flies and ticks. The damage chargeable to the ox warble was very carefully investigated several years ago by a western farm paper, and from the averages reported from the chief cattle States of the Mississippi Valley it was shown that 50 per cent of the cattle received in the Union stock yards at Chicago during the grubby season (from January to June) were infested and more or less injured by the presence of the larvæ of this insect. The depreciation in the value of hides and the lessened quantity and poorer quality of the beef indicated a total loss during the season in question of over $3,000,000. This loss applies only to the cattle coming to the Chicago market during the period mentioned, and is merely an indication of the much greater loss to range and farm stock throughout the country from this one pest. The

loss for Great Britain from the warble has been estimated to vary from $10,000,000 to $35,000,000 per annum, and the total for the United States certainly can not fall below that for Great Britain.

The shrinkage or check to fattening due to the annoyance from biting flies and other insect pests of cattle represents a very considerable total every year, probably, in view of the greater prevalence of these pests, much more than is chargeable to the ox warble.

Horses, sheep, and other farm animals are subject to the attacks of similar parasites and other insect enemies, and if all these be considered, including, for example, the buffalo gnats, often very destructive in the South, the many gadflies, botflies, the screw-worm fly, and such parasites as the ticks and lice, a heavy percentage of loss must be reckoned. A 10 per cent annual loss has been assigned, certainly a conservative estimate, which represents a shrinkage in stock values due to insect pests of $175,000,000.

INSECT DAMAGE TO STORED PRODUCTS.

The estimates given in the foregoing relating to vegetable products give the shrinkage due to the attacks of insects to the growing and maturing crops. After these crops have run the gauntlet of insect enemies during their entire period of growth—and this applies notably to the cereal and forage crops and to tobacco and certain truck crops—they are still subject to the inroads of another class of insect depredators while in storage on the farm, or, in greater accumulations, in elevators and mills, or, again, while in transit, especially in the case of long shipments by sea. The cereals are all kept in storage until consumed, which means a considerable period for the bulk of the crop. The various grain weevils and beetles, flour moths, and other insect pests which depredate on stored grains frequently cause great losses, and an estimated injury of 5 per cent is a reasonable and probably minimum figure. Computing this percentage, therefore, on the valuation of the cereal products for 1904, we have indicated an annual loss of $100,000,000.

The location of food products for human consumption is in the house storeroom and kitchen, and often this last opportunity for insect damage is improved by various species of the stored-grain pests already referred to. Animal products are attacked by larder beetles, ham beetles, etc., fruits by various fruit and vinegar flies, and the woolens or the household furnishings by carpet beetles, clothes moths, silver fish, etc.

Cured tobacco is especially subject to insect attacks and damage, the most important source of injury being a minute insect known as the cigarette beetle, which not only eats into cigarettes, but all other forms of cured tobacco. It is now widespread in America, occurring in

practically all factories, warehouses, and retail establishments, and is frequently the cause of very heavy losses.

In the general table a total loss of $100,000,000 is indicated for insects attacking stored products. This is covered by the loss indicated for cereal products alone, and if the other items of loss just enumerated were included a considerable increase in the estimate could legitimately be made.

CONCLUSION.

A general analysis of the insect losses for this country has been given in the introductory paragraphs. In concluding it is only necessary to emphasize again the fact that these losses, enormous as they are estimated to be, could be legitimately swelled by adding the secondary losses which, in the case of the great staple productions of the farm, follow any considerable shortage and ultimately add to the cost of living for every individual, in addition to creating large commercial disturbances. Furthermore, the cost of protection from insect damage has been considered only in the case of one or two products of the farm. Another considerable insect tax not estimated for is the direct loss and the cost of protection from domestic or household insect pests. Screening of houses against mosquitoes or flies, protection from roaches, clothes moths, and the ravages of the white ant and of various parasitic insects, are a charge on every household. The white ant in Washington, D. C., alone causes losses of thousands of dollars yearly, and it is much more destructive in southern districts. If the smaller or larger sums expended for protection from such pests were tabulated for the whole country, the total would probably exceed $50,000,000, and might be double that amount. An omission perhaps more important than any of these is the indirect loss to the producing and earning capacity of communities by diseases conveyed by insects. For example, malaria and yellow fever are dependent solely on certain species of mosquitoes, and typhoid fever is commonly carried, as shown by Dr. Howard, by house flies. The losses from all three of these diseases are enormous, and in the case of yellow fever outbreaks, often almost beyond computation. With domestic animals the tick, responsible for Texas fever in the South, has been estimated to cause an annual loss of $100,000,000, and other diseases of man and domestic animals will undoubtedly be shown to depend exclusively or largely on biting or other insects. In view of these omissions, the writer is convinced that the total of over $700,000,000 annual loss assigned to insect pests in America is below rather than above the actual damage. The lessening or prevention of this loss is the problem for the economic entomologist to solve.

COTTON CULTURE IN GUATEMALA.

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INTRODUCTION.

During a visit to the famous Coban coffee district of eastern Guatemala in 1902 it was learned that a field culture of cotton was regularly

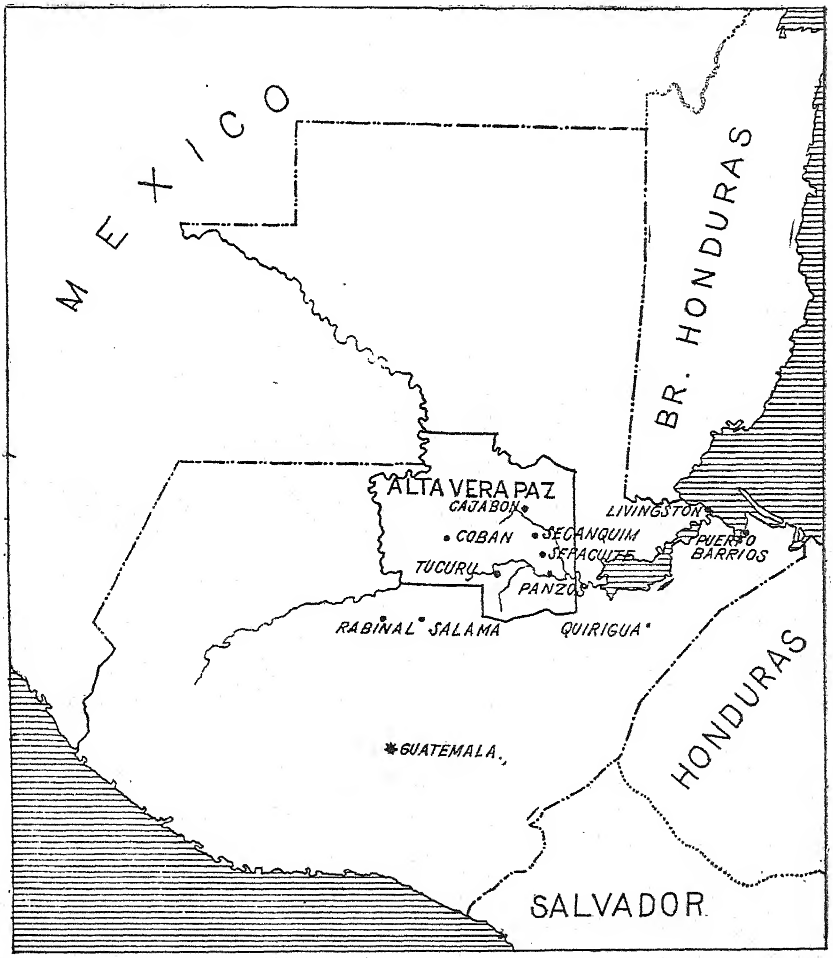


Fig. 59.—Map of Guatemala, showing localities mentioned in the text. The Kekchi cotton and the keleps were found at Secanquim.

maintained by the Kekchi Indians, a primitive tribe inhabiting the region between Coban and Cajabon (fig. 59). The Indian variety

of cotton attracted attention from the first by reason of the very small size of the plants and because they seemed not to be injured by the boll weevil. Numerous specimens of this destructive weevil were found, however, on a perennial "tree" cotton growing only a few rods away. In the early part of 1904 another visit was made to Guatemala for the express purpose of studying cotton culture as practiced in that country, to learn whether the Indian variety was indeed immune to the boll weevil, and for what reason.

It was then found that the Kekchi cotton is protected by the kelep, an ant-like insect which feeds upon the boll weevils. It was also learned that this and other Guatemalan varieties of cotton have special characters which assist in protecting them from the weevils. Some of these weevil-resisting adaptations may be of use in the United States, since the cotton varieties cultivated by the Guatemalan Indians belong to the Upland type so extensively planted in this country. The nature of the protective characters and cultural methods observed in Guatemala can best be understood, however, with certain local conditions and historical facts in mind.

THE AMERICAN ORIGIN OF UPLAND COTTON.

So large a majority of our cultivated plants were brought from Europe or from other parts of the Old World that there has always been a tendency to disregard the exceptions and make the generalization complete. The American potato has been ascribed to Ireland, the American artichoke to Jerusalem. Our maize or Indian corn is commonly known in Europe as "Turkey corn" or "Turkey wheat." "Turkey" is also our English word for the familiar fowl domesticated by the aborigines of America. Medieval Europe evidently took it for granted that everything new in the line of domesticated plants and animals should come from the East, whence the crusaders had brought so many novelties.

Many books of reference give the dates at which cotton was introduced into the English colonies of North America, leaving the implication that the seed was brought from Europe, and that it served as the basis of the agricultural industry of the present day.[a] More

[a] Works of high botanical authority make definite statements to this effect. Even in Engler and Prantl's Natürlichen Pflanzenfamilien we are informed that *Gossypium herbaceum*, the species of cotton described by Linnæus from the Levant, is extensively cultivated in the United States. A few years ago seeds of what is apparently the same variety of cotton as that described by Linnæus were brought home from Asia Minor by Mr. Walter T. Swingle of this Department. The identification of this cotton as the true *Gossypium herbaceum* of Linnæus was made by Mr. Lyster H. Dewey, Botanist in Charge of Fiber Plants. Mr. Dewey's results were announced at a meeting of the Botanical Society of Washington, January 7, 1904. (See Dewey, L. H., The Identity of American Upland Cotton. Science, N. S., 19: 337.) Comparison of growing plants shows that this Levant or *herbaceum* cotton is a type very different throughout from any cotton now cultivated in the United States.

detailed evidence will be submitted elsewhere; for present purposes it may suffice to state the conclusion that the Upland cotton which Linnæus correctly recognized as distinct from the Old World *herbaceum*, and to which he gave the Latin name *Gossypium hirsutum*, is a native of tropical America. Both the Upland and the Sea Island cottons were originally described from the West Indies.

ANTIQUITY OF COTTON CULTURE IN GUATEMALA.

The fact that cotton culture exists in Guatemala in the presence of the boll weevil, and the probability that it has so continued to exist for unnumbered centuries, lend interest to the agricultural history of the Central American region. There need be no fear, apparently, of overestimating the time factor in connection with the development of weevil-resisting adaptations of the Central American varieties of cotton. The indications are all in the direction of the great stability and antiquity of the native populations of Central America. The people are peaceable and sedentary, with highly developed agricultural instincts, which attach them closely to the land which their fathers cultivated, and there is no reason to suppose that any very different condition existed in earlier times.[a]

Many biological facts support the views of the ethnologists who have ascribed a very great antiquity to the primitive civilizations of the Central American region. Districts now covered with tropical forests which it would take many centuries to establish have evidently been occupied, not once, but at least two or three times, by agricultural populations. This fact means that the land was cleared, denuded (Pl. LXV, fig. 2), abandoned, and reforested. The antiquity of cotton culture in America is also indicated by its very wide distribution throughout the tropical and semitropical regions of North and South America. Before the arrival of Europeans, cotton was spun and woven into cloth by extremely primitive tribes who have, even to this day, no other arts of any similar degree of complexity. The invention of the loom did not, however, mark the beginning of the use and domestication of cotton in ancient America. The early explorers found cotton in cultivation among many tribes who wore no clothes. They used it for making hammocks, for wrapping the darts of blowguns, weapons which preceded the bow and arrow in America, and finally, or earliest of all, cotton was used as tinder in the making of fire by friction, which ethnologists consider the most ancient of distinctively human arts.

[a] It has been noted by Maudsley that the more ancient sculptures of the Maya peoples give no indication of warlike tendencies, and even those of Yucatan show no bows and arrows, though the Indians of Mexico fought with these weapons when the Spaniards arrived.

FAILURE OF COMMERCIAL COTTON CULTURE IN GUATEMALA.

Help in the solution of the boll-weevil problem has not been expected from Central America, probably because that region contributes nothing to the world's commercial supply of cotton. The fact that the Indians grow cotton has served, however, as a suggestion of the practicability of establishing a remunerative industry of this kind. Such experiments have been tried repeatedly on both sides of that country, in some instances on a large scale and under competent management. Uniform failure has been the result, sometimes in the first year and sometimes after one or two promising crops had been secured.

The presence of the boll weevil affords, of course, a ready explanation of the impracticability of cotton culture in Guatemala, conducted under the methods employed in the United States and other centers of production. It has been demonstrated in Texas that in favorable seasons paying crops of cotton can be produced in spite of the presence of the boll weevil, but this is possible because only a small portion of the insects survive the winter. In Guatemala there is no winter to reduce the number of the boll weevils, and the standard varieties of cotton of which seed is imported as the basis of the commercial experiments become, in tropical countries, perennial plants, on which the weevils can continue to propagate throughout the year.

All the cotton used by the civilized population of Guatemala is imported, but the Indians have continued to produce small quantities for their own use by taking advantage of facts which they could not explain to others, because they did not understand them themselves. Though probably a native of the country, the boll weevil seems to be unknown to the Indians, or at least is not recognized as an enemy of the cotton. Nevertheless, the Indians have learned, through long and unconscious experience, to use cultural expedients which protect them against the ravages of the weevil, and have developed through selection varieties of cotton with characteristics which render their systems of planting the more effective. Whether these Indian methods and cotton varieties can be utilized in the United States or not, they have suggestive interest, at least, for those engaged in the warfare against the boll weevil.

COTTON CULTURE AMONG THE INDIANS OF CENTRAL GUATEMALA.

The Indian cotton culture with which the more civilized part of the population, and some of the foreign residents, have come into contact is that of the central plateau region, in which are located the towns of Salamá and Rabinal, early and important centers of Spanish colonization. The continued failure of experiments in cotton culture by the

FIG. 1.—KEKCHI COTTON PLANT.

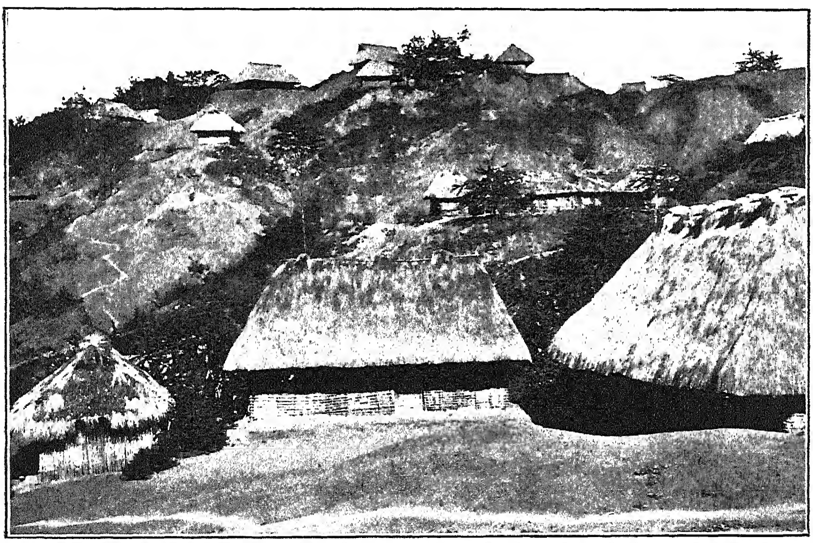


FIG. 2.—KEKCHI TOWN (CAJABON), SHOWING DENUDED LAND.

civilized inhabitants, including one which was being made at Salamá under Government auspices at the time of our visit in 1904, is explained locally by the theory that the cotton requires the extremely rich soil only to be found immediately behind the houses of the Indians, since it is only in such places that the plant reaches productive maturity. It was not difficult, however, to ascertain that the weevil, rather than the soil, was causing the failure of the recent experiment, as it had, presumably, those of earlier date. An examination of the Indian method of culture also gave definite indications of the means by which the weevil is avoided.

The cotton cultivated by the Indians at Salamá and Rabinal belongs to the Upland series, but is a perennial variety. The stalks, however, are not permitted to stand from year to year, but are all cut back to the ground annually, about the 1st of May. By this simple and yet very effective expedient they render this perennial cotton earlier than annual varieties. At the time of our visit, in the latter part of May, the new shoots, though less than a foot high, were already showing numerous buds, and it is by this quality of prompt flowering that the plants are able to mature a crop. The cutting down of the old stocks permits the weevils to be caught by the flocks of turkeys and chickens which spend their time about the back doors of the Indian houses, and the young plants are doubtless protected in the same way as long as they are within reach from the ground. All stocks of the previous year which had not been cut back were heavily infested with weevils; so much so, in fact, that we were unable to secure uninjured bolls to preserve as specimens of this variety.

The central plateau region of Guatemala has a long and very severe dry season, which might be a means of protection against the weevil under the proper methods of culture, but the Indian system takes no advantage of the dry climate, or, rather, it completely neutralizes the possible advantages by planting the cotton very close together. The Indians sow literally a handful of seed in a place, and have ten or a dozen plants in a space a foot square. These clusters are themselves so close together that the ground is completely covered and shaded before the plants are half grown.

The dryness of the climate and, perhaps, a special instinct developed through selection by the turkeys, may cause the weevils to remain hidden away among the cotton plants after the new growth has begun, instead of migrating freely from one thicket to another. At least we found small patches of cotton only a few rods apart, some with few or no weevils and others so thickly infested that growth was impeded. The weevils were gnawing the young leaf buds and causing them to blast, which compelled the starting of new lateral shoots. The

leaves were also notably distorted, so that it was easy to recognize the weevil-infested patches from a distance.

A further evidence that the very prompt flowering of the new shoots is the character which enables the cotton to avoid more serious injury by the weevils is to be drawn from the fact that the Indians expect a very small yield, or none at all, from their cotton in the year in which it is planted. This is not because the new seedlings remain smaller than the other plants, even during their first season, but they are slower in starting, so that by the time they begin to flower the weevils may have become sufficiently numerous to prevent the setting of a crop.

Nevertheless, it is likely that this cotton is, even in the first season, an early maturing variety, and it may not be without value in the higher and drier districts of western Texas, where cotton culture is likely to become of increasing importance in the future, unless the more humid eastern counties can secure more adequate protection against the weevil. A considerable amount of cotton is still produced by the Indians in these very small dooryard patches, often only a square rod or two in extent, but not nearly enough for the local consumption. Much imported thread is now woven in the native looms, to say nothing of the use of foreign fabrics.

The decline of cotton production in this region is very possibly connected with the gradual substitution, in the last hundred years, of chickens for the turkeys, which the early explorers tell us were extremely abundant in the Indian villages. Turkeys are well known as extremely active and sharp-sighted hunters for insects, and they are also able to reach much farther up on the plants than chickens.

The involucre of this variety of cotton is relatively small and open, and the weevils are the less able to conceal themselves effectively. The turkeys which protect the cotton of these Guatemalan Indians are not the so-called Guatemala turkey (*Meleagris ocellata*), a brilliantly colored wild species valued as a game bird, but are a nearly black variety of the familiar domesticated fowl, though of somewhat smaller size than those known in the United States. They have the virtue of extreme tameness and stay close about the houses, having lost the wandering instincts of our less perfectly domesticated varieties. Long and intimate contact with the cotton had given the Indian turkeys special training as weevil destroyers.

TWO TYPES OF INDIAN AGRICULTURE.

The fact noted above, that in central Guatemala the cotton is all grown, as it were, in the dooryards of the Indians, is significant of the whole social and agricultural organization of the community, which is entirely different from that of the Indians of Alta Vera Paz, where

the annual variety of cotton is cultivated with the assistance of the weevil-eating keleps. The central plateau region of Guatemala has long contained a large population. All the fertile soil is cultivated, and there are no longer any forests except the open growth of pines and oaks which takes possession of denuded and abandoned areas. Agriculture is now confined entirely to the nearly level bottoms of the broader valleys, the slopes having become too dry for cultivation. The proportion of fertile land is very small, comprising mere pockets of deep rich soil, which still yield crops after centuries of continuous cultivation. Such land is considered valuable, of course, and family holdings are usually small, mere yards or *sitios*, as they are called, an acre, more or less, in extent.

A very different system prevails in the lower and more humid eastern districts of Alta Vera Paz, where the country is much broken and the valleys narrow and deeply eroded. Crops are grown, of necessity, on the slopes, and often on those of great steepness. The agriculture of the Kekchis might be described as nomadic, since it is the regular custom to cut and burn every year a new clearing or *milpa* for planting corn, beans, and other crops.[a] Under the *sitio* system of the central plateau the Indians live continuously in large, widely scattered, but permanent village communities, each habitation being surrounded by a small tract of land, from which the family has had an annual crop of corn for many generations back. The *milpa* Indians, the makers of the annual clearings, also have a few towns, but they grow little or nothing about their houses, and spend most of their time away from home planting, watching, and harvesting their crops. To reach good *milpa* land they will travel considerable distances, sometimes 50 miles or more, and carry home on their backs the corn necessary to support them during their stay in town.

Both the *sitio* and the *milpa* Indians cultivate corn as the principal field crop, but cotton has a very different status in the two systems of agriculture. In the country of the *milpa* Indians the cleared land in and about the towns is continuously eroded, so that only trees can be

[a] For crops other than cotton a new clearing is made every year. The land is cleared by burning, and the heavy rainfall rapidly washes away the fertile surface soil, so that agriculture is not permanent. If the Indians are few and scattered, the forest will renew itself between successive clearings, but when the population becomes too large the land is burnt over too frequently, and reaches, finally, a state of almost complete denudation. For many years only grass and scattered pines will grow. Whole districts have become useless for agricultural purposes, and have been abandoned for long periods. About towns, in particular, there is little land which has not suffered severely (Pl. LXV, fig. 2), and the people are compelled to go longer and longer distances to reach land suitable for planting, or even to secure fuel for cooking. Firewood and building materials are commonly carried into such towns as Cajabon, Carchá, and Coban from distances of 2 leagues or more, on the backs of men.

planted around the houses, and cotton has to be grown in the *milpas* as a field crop, a fact which at once lends to this culture a practical interest greater than that of the *sitio* Indians.

This Indian field culture of cotton is located in the Cajabon district, a very inaccessible part of Guatemala, seldom visited by travelers, and its very existence seems to be quite unknown outside the immediate vicinity. The climate of the neighboring coffee belt is too cool and wet for cotton. The first finding of the cotton, in 1902, was quite accidental. It resulted from the kindly insistence of Mrs. William Owen, hostess at the Sepacuite coffee estate, that we visited the Cajabon people, whom she appreciated as a most interesting remnant of aboriginal life and agriculture.

AGRICULTURAL HABITS OF THE KEKCHI INDIANS.

The Indians of eastern Guatemala are what Prof. Otis T. Mason felicitously terms "poor relations of the Mayas." They are similar in language and customs to the people who, previous to the coming of the Spaniards, had attained an advanced state of culture in Yucatan, and who are supposed to have built the massive stone structures which are still the wonder of archeologists. To the southward near the border between Guatemala and Honduras are the famous ruins of Copan and Quirigua. Eastern Guatemala, though lying between these two centers of ancient civilization, seems never to have had a period of equal advancement, at least as far as indicated by architectural remains, though traces of ancient occupation are very frequent over the whole region.

The Spanish invaders found no cities to capture and no precious metals. The very lack of organization among the Indians rendered it unusually difficult to make a definite conquest by force of arms. This part of the country was finally turned over to the missionaries, who, under the leadership of the humane Las Casas, were able to achieve a peaceful occupation, a fact commemorated in the name Vera Paz, meaning True Peace. The missionaries made many efforts to collect the people into villages in order to teach them European habits of life, but their agricultural system does not conduce to the formation of centralized communities. Since the withdrawal of the Spanish influence the towns have continued to decline, though the Indian population as a whole is said not to be decreasing.

The Indians of Alta Vera Paz are a contented people, completely satisfied with their present state, except for the necessity of working one week in four on the coffee plantations in accordance with the contracts on which they lease their present holdings of land. They want nothing in the way of foreign goods, and would much prefer to be left

completely alone by the white men. Unlike the natives of Africa, they seem not to be attracted by civilization, and have no desire to become white men or even to imitate them. They have refused to adopt European clothes, or to learn the Spanish language. They cultivate no crops and use no food not known to them before the coming of the Spaniards. This persistent conservatism has enabled them to preserve their aboriginal methods of agriculture and their native varieties of cultivated plants, including the cottons, which form the subject of the present report.

THE WEEVIL-EATING KELEP.

The growing of cotton among the Kekchis was found to be assisted by a large, reddish brown, ant-like insect, which feeds upon the weevils. The kelep, as the Indians call it, is strikingly adapted by structure and instinct for the work of protecting the cotton against the weevils. Its large jaws or mandibles are so shaped as to fit neatly about the middle of the weevil and hold it firmly, while the long, flexible body is bent around underneath to insert the sting. The weevil has a hard shell which protects it from other insect enemies, but the kelep has a highly specialized instinct which enables it to find and penetrate one of the two vulnerable points on the median line below.[a] The effect of the sting is to paralyze the weevil, after the manner of the wasps, which store their nests with spiders or caterpillars for their young to feed upon. The kelep, however, does not sting the weevils to preserve them. As soon as the poison has taken effect and the weevil has ceased to struggle, it is carried down into the subterranean nest and pulled to pieces to feed the growing larvæ.

The kelep is thoroughly predaceous and makes no use of vegetable food other than the nectar by which it is attracted to the cotton plant. It does not confine itself to the boll weevil, but attacks and kills many other insects found upon cotton, including the larvæ of bollworms and leaf worms, as abundantly shown by the colonies imported into Texas. Nevertheless, the nectar appears to be an important consideration, and the kelep manifests a decided preference for cotton over other vegetation.

It was not merely a theory that the presence of the kelep explained the scarcity of the weevils in the Indian cotton fields. The obliging insects would generally take captured weevils from our forceps, or even from our fingers, and give them the regular treatment before our eyes. Remains of the hard parts of the boll weevils were found in the nests of the colonies which were dug out and brought to the

[a] In a great majority of cases the sting enters between the thorax and the abdomen, but a few instances were observed by Mr. C. B. Doyle in which the mortal wound was inflicted between the head and the thorax.

United States. The keleps have the curious habit of storing in special chambers the dismembered skeletons of the captured insects.

Inquiry among the Indians developed the fact that one old man had been planting cotton for about forty years on the same hillside and in closely adjacent places. When asked whether there were not some years when he got no crop of cotton the reply was, "Yes; some years ago when I was sick and did not plant." A regular and uniform yield would show that a balance between the keleps and the weevils has been established; otherwise there would be, as in Texas, great fluctuations in the amount of damage done by the weevils and in the resulting crop of cotton. If the weevil lives, as now supposed, only on cotton there are chances, of course, that fields planted in new and remote situations might not be reached by the pests until the cotton had had time to set a crop, but this immunity would probably be very brief anywhere in Guatemala.[a]

INTRODUCTION OF THE KELEP INTO THE UNITED STATES.

As soon as the discovery of an insect enemy of the boll weevil was reported to the authorities of the Department,[b] cabled instructions were sent back to spare no effort toward introducing the insects into the United States. This seemed at first a very difficult task, since our outfit included none of the laboratory appliances which have usually been employed in handling such insects in captivity. It was found possible, however, to construct for the keleps artificial nests of stones and earth in glass jars, and in such cages about ninety colonies were brought safely to Texas, where experiments have been conducted to determine whether they can survive the change of climate and other natural conditions and be made of practical use in the cotton fields of that State.

The keleps are well adapted for domestication, and have shown no injurious or objectionable habits. It has proven entirely feasible to capture them in numbers, bring them to Texas, and colonize them in

[a] In the valley of the Polochic River, below Tucuru, there was found a small piece of cotton, about 3 rods square, planted on flat land in the river bottom, where there were no keleps. Our Indian guide insisted that there was no other cotton nearer than the town, about 4 miles away. A crop had been harvested, but flowers and young bolls were still forming. At first it seemed that this might be the long-sought example of a field of cotton successfully hidden from the weevils. Finally, however, two or three badly infested plants were found with all the buds punctured and several of the beetles still at work. They represented, probably, a comparatively recent arrival, otherwise it is difficult to understand why they should not have spread more uniformly over so small a field.

[b] Cook, O. F., 1904. An Enemy of the Cotton Boll Weevil, Report 78, U. S. Department of Agriculture.

the cotton fields.[a] A cold-storage experiment indicates that freezing alone is not fatal, but this is far from proving that they can survive the winter season of Texas, with its severe alternations of temperature and floods of cold water.

The insects behaved normally during the growing season, and some of the colonies have shown their ability to breed, both in captivity and in the cotton fields of Texas. The colonies brought home from Guatemala were, however, nearly all too small to make the experiment a fair one, the extent to which the habits of the kelep differ from those of the true ants not being realized at first. The keleps have a more highly developed social system than the ants. New colonies are founded by the subdivision of older communities, as among the honey bees, not by solitary females, as among the ants.

The popular press has often discussed the "Guatemalan ant" as having been introduced to "exterminate the boll weevil," but this has not been expected by anybody conversant with the facts. In Guatemala, where both insects are apparently native, the weevils have not been exterminated. They are still present in numbers which forbid continued field cultures except where the cotton is protected by the keleps. The most that can be said is that they keep the weevils in check, and thus permit cotton to be regularly harvested under cultural and climatic conditions which in Texas would result in the total destruction of the crop.

If the keleps survive in the United States they are likely to supplement rather than to supersede the protective adaptations of the cotton plant itself. In fact, their true value can not be fully determined until the extent of these adaptations has become thoroughly known.

COTTON CULTURE OF THE KEKCHI INDIANS.

The methods of planting and cultivating cotton among the *milpa*-making Kekchis differ as much from those of the Rabinal people as do their agricultural systems as a whole. Instead of having their cotton in dense clusters, the Kekchis have an open culture not unlike that of the Southern States, though there are no straight rows. The rule is to plant about six seeds in a place, at distances of 3 or 4 feet. Two or three plants usually reach maturity, and these together may produce as much as a large plant in Texas, from ten to twenty-five bolls being the usual number under favorable conditions.

Where the soil is too poor or too dry to permit the cotton to grow more than 6 or 8 inches high it will still mature one or two bolls, which shows the promptness with which bearing begins. Nearly all the bolls are formed near the ground, on long lateral branches

[a] Cook, O. F., 1904. Report on the Habits of the Kelep, or Guatemalan Cotton-Boll-Weevil Ant, Bulletin 49, Bureau of Entomology, U. S. Department of Agriculture.

(Pl. LXV, fig. 1), which may be looked upon, perhaps, as still another means of protection against the weevils, whose instincts lead them to seek the buds and bolls at the top of the plants.

When the Kekchi cotton was first discovered in 1902 its small size was looked upon as likely to exclude it from use in the United States, but in the development of the policy of avoiding the injuries of the weevil by shortening the growing season the dwarf habit may prove a most desirable character. By depending upon many small plants instead of fewer large ones it may be possible to produce the same number of bolls in less time. Close planting of large free-growing varieties might postpone the setting of the crop, but with a naturally dwarf, early-bearing variety this difficulty is avoided.

CHARACTERS OF THE KEKCHI COTTON.

The weevils and the Indians together have carried on a selection for quick growth and early bearing. In fields where there are not enough keleps to maintain an efficient patrol, only the earlier buds would receive attention, and even in favorable situations the protection is probably not as effective after the plants have become full grown.

The Kekchi Indians are accustomed to planting peppers with their cotton, to ripen somewhat later. To make room for the development of the pepper plants, the cotton is generally removed as soon as the principal portion of the bolls has opened. The result of these unconscious selections for earliness is that the Kekchi cotton, though growing in a tropical region not visited by drought, ripens its crops in six months after planting.

It is well known that most of the cotton varieties are annual only by reason of the limitations of our temperate climate. If carried into humid tropical countries they revert at once to the perennial habit of growth. The experiment of planting the Kekchi cotton in the United States is to be tried in the coming season, and it is not impossible that after two or three years of acclimatization it may prove to be a very early sort, which will mature cotton even more promptly than the King and other quick-growing varieties recently recommended as a means of avoiding complete destruction by the boll weevil. Dr. Herbert J. Webber, to whom samples of the Kekchi cotton have been submitted, states that the fiber is of good quality and length—an inch and a quarter—and that it could enter the regular markets with the lint of other Upland varieties. Plate LXVI, figure 2, shows samples of the Kekchi cotton in comparison with King. The bolls also are of good size (Pl. LXVI, fig. 1).

The devotion of the keleps to the cotton is not, as we have seen, mere disinterested philanthropy, and it is a significant fact that the

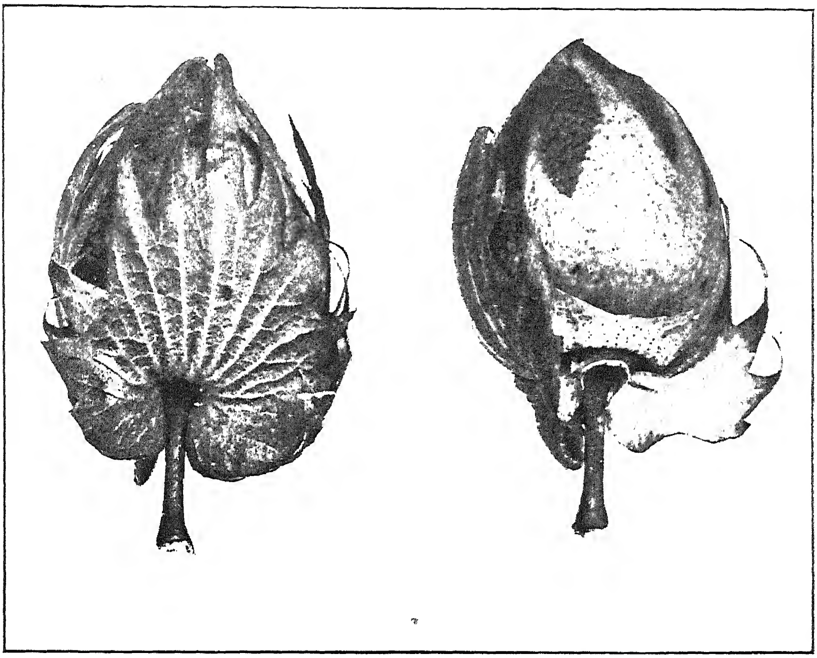


FIG. 1.—MATURE BOLLS OF KEKCHI COTTON.

[Natural size.]

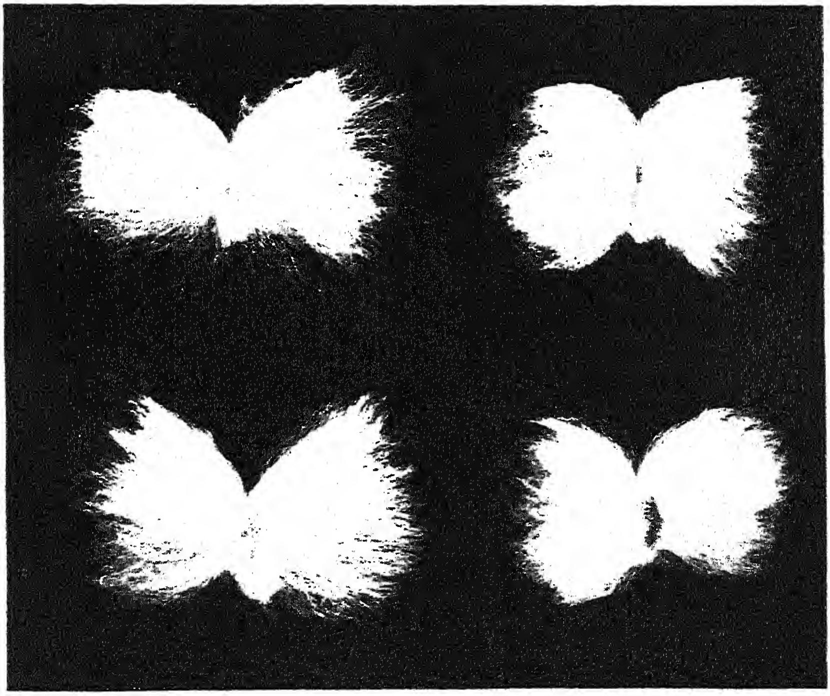
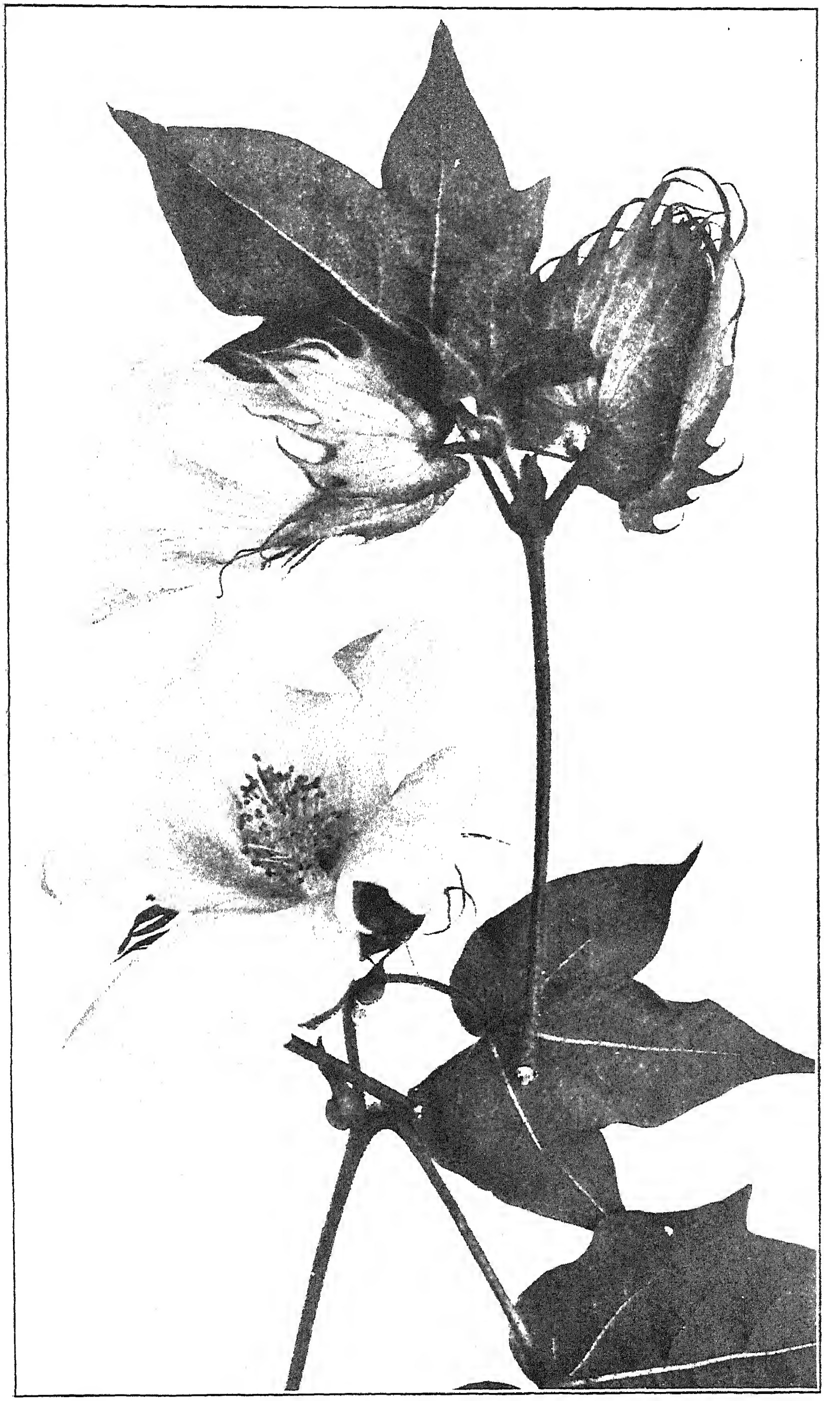


FIG. 2.—LINT OF KEKCHI COTTON (LEFT) AND KING COTTON (RIGHT).

[Natural size.]



LEAVES AND FLOWERS OF KEKCHI COTTON.

[Natural size.]

Kekchi cotton has larger and more active extrafloral nectaries than any other variety known. The nectaries of the leaves are not more developed, perhaps, than those of some other varieties, but those at the base of the involucre, where the presence of the kelep would afford most protection, are very large and active (Pl. LXVII) and secrete nectar for a longer period than those of other kinds of cotton. As reported by Professor Trelease, several years ago, most of the varieties now planted in the United States secrete nectar only at the time of flowering, but the Kekchi cotton begins earlier and continues the process until the bolls are nearly full grown.

HOW THE COTTON PLANT CAN RESIST THE WEEVIL.

It was also noticed in Guatemala that the buds do not always drop off after being punctured, and that the young bolls sometimes continue to develop in spite of the attacks of the weevil. This fact was previously known in Texas, but the death of the weevil larvæ inside the buds had been ascribed to the disorganization or so-called "gelatinization" of the tissues of the plant. It was found, however, by an examination of the earlier stages of the process, that there is an actual growth of nearly normal tissue into the cavity eaten out by the weevil larva, and with a uniformly fatal result. The larva, in its younger stages, subsists entirely on the highly organized food material to be found in the pollen grains. The new tissue formed by mere swelling or proliferation from the central column of the flower (Pl. LXVII) is poor and watery and may starve the larva to death, if it does not act as a poison.

There is, in short, a means by which cotton is able to offer an effective resistance to the weevil, and if a variety could be obtained in which the new growth or proliferation of the internal tissue took place regularly, the weevil might even be exterminated.[a] Such a variety may possibly exist already in some part of tropical America, but if this should prove not to be the case, it is probable that the tendency to proliferation can be increased and rendered constant by selection.

CONCLUSION.

Among the Indians of eastern Guatemala there are two systems of agriculture in which cotton is regularly cultivated in spite of the presence of the boll weevil, but neither the cultural methods followed by the Indians nor the assistance rendered by the weevil-eating keleps would be effective in the absence of the protective characters and habits of growth of the Indian varieties of cotton, which have been attained, we may believe, as a result of thousands of years of unconscious selection.

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[a] Cook, O. F., 1904. Evolution of Weevil Resistance in Cotton. Science, N. S., 20: 666–670.

The proliferation of the internal tissues of the bolls, which kills the weevil larvæ, affords at least a suggestion of complete relief from the pest, and other protective agencies doubtless remain to be discovered in other parts of tropical America. The kelep may or may not be able to thrive and multiply in the United States, but the fact that the boll-weevil problem has been solved independently in two Indian cotton cultures of eastern Guatemala, less than a hundred miles apart, would seem to show that the case is by no means as desperate as at first feared, and permits a lively hope that similar results may be attained in the cotton-growing districts of the Southern States.

BOYS' AGRICULTURAL CLUBS.

By Dick J. Crosby,
Of the Office of Experiment Stations.

THE CORN EXHIBIT AT THE ST. LOUIS EXPOSITION.

"Grown by the farmer boys of Illinois!" "Eight thousand farmer boys in contest!"

All summer long these two legends surmounted two large pyramids of pure-bred corn at the Louisiana Purchase Exposition—pyramids made up of 1,000 little pyramids, each containing 10 beautiful ears of white or yellow corn, straight-rowed, symmetrical, uniform. The exhibit was a monument alike to the industry and intelligence of 8,000 Illinois farmer boys and to the energy and resourcefulness of Mr. Will B. Otwell, who had charge of the Illinois agricultural exhibit at St. Louis, and whose helpful work among these boys during the past four or five years made such an exhibit possible. A series of intensely interesting events leads up to this corn-growing contest, but only a brief sketch of them can be given here.

About five years ago the secretary of the Macoupin County (Ill.) Farmers' Institute, who had had some experience in advertising, undertook to get out a large attendance of farmers for the annual institute. He advertised the meeting in 13 county papers and instructed the janitor of the court-house to open the doors early to accommodate the crowd. On the day of the institute the attendance was limited strictly to the president, the secretary, and the chaplain. "And," says the secretary, "the chaplain offered a fervent prayer for the officers of the organization. I tapped him on the shoulder afterwards and told him he would oblige me by praying for the delinquent farmers who were absent; the officers were doing everything in their power."

The next year the secretary changed his tactics. After engaging the services of many noted speakers on subjects of interest to all good farmers, he had a lot of gilt-edged programmes printed. These were mailed, like wedding invitations, in nice square envelopes, to 500 farmers of the county. The day of the institute arrived, the janitor had the doors open early, and about two dozen farmers attended. The officers were disgusted, the president resigned, and the secretary was elected president. The latter, fortunately, was as resourceful as he was persistent, and his next experiment was both original and successful.

He first wrote to leading corn growers in Iowa, Indiana, and

Illinois and procured 12 samples of first-class seed corn. He then called 12 farmers into the parlors of a local bank and asked them to select the variety best adapted to the soil of Macoupin County. This done, several bushels of the seed corn were secured at $2 per bushel. The president next solicited $40 in cash and divided it into $1 premiums. A plow company gave a two-horse plow to be offered as a sweepstake premium. Notices were then inserted in the county papers to the effect that every boy under 18 who would send in his name and address would receive a package of this seed corn—all that could be mailed for 1 cent postage. The president says:

Five hundred boys sent for the corn and began contesting for the premiums. All summer long these boys were talking farmers' institutes (where the corn was to be exhibited). They were comparing notes and exchanging ideas until our institute was a topic of general conversation. I decided not to advertise the institute in the papers any more than just to give the dates. The farmers were politely told they could stay away from the institute if they preferred. When I reached the courthouse on the morning of the institute there were scores of boys waiting for the doors to be opened. They had their prize corn with them, some of it in boxes, some of it in coffee sacks, tied up with binder twine, shoe strings, bedcord—any way, just so they got it to the institute. When I called that meeting to order at the appointed time I was confronted by 500 farmers. And Professor Stevenson, of Champaign, who scored the corn, said he had never seen a nicer display of yellow corn. I knew I had solved the problem, and so did the farmers. The boys were in evidence everywhere, and their presence was an inspiration to the institute.

The next year there were 1,500 farmer boys in the contest, and it took $300 to provide the prizes, which consisted of a high-grade bicycle, a three-wheel riding plow, a walking cultivator, a 10-foot windmill, a fanning mill, a double harrow, a 16-inch walking plow, a washing machine, a one-hole corn sheller, a hand plow, 2 rolling colters, a box of 100 bars of soap, and 140 one-dollar premiums.

The summer that followed was a dry one, and the president of the institute was fearful that the contest would not amount to much. But one of the objects for which he was striving had already been accomplished—the farmers of the county were interested. The fathers of the 1,500 boys donated the best spots on their farms for the growing of this corn—the hog lots, calf pastures, clover fields—and all the time the boys were studying deep and shallow cultivation and fertilizers of all kinds, and were becoming more interested in farming, "so that to-day there is a prevailing belief in this county that boys may choose farming as a profession and still be as good as anybody."

When the time for the farmers' institute came there were 1,500 farmers in constant attendance and a display of corn which, according to the judge who distributed the prizes, was finer than any he had ever seen at State fairs in Illinois, Indiana, Kansas, or Iowa. Mr. Otwell says of this meeting:

Farmers who two years before would not attend, and who boldly asserted that "they had forgotten more than those speakers would ever find out," were on the

front seat and helping in every possible way. Besides the fathers and mothers and sisters and sweethearts, there were more than 300 farmer boys in attendance at this institute, and with no friction and the utmost enthusiasm and good will, we closed the largest and best farmers' institute I have ever attended. The corn was simply immense. And so were the boys. And when I mentioned the name of the poor little fellow in blue overalls, who lived on a thin, worn-out piece of white land, and who had carried water all through the long summer to water his corn, and had thereby been awarded the first prize (bicycle), no governor of the State of Illinois ever received a heartier ovation than he.

The problem of arousing an interest in farmers' institutes and in the questions discussed at them had been solved. The farmers were reached through their children, and the interest thus aroused will be handed down to their children's children.

When the president of the Macoupin County Farmers' Institute was asked to take charge of the Illinois agricultural exhibit at the Louisiana Purchase Exposition he determined that the farmer boys should take an active part in preparing the display. He got up a list of premiums costing $3,500, printed the premium list and the rules governing the contest, and mailed them to 120,000 farmer boys in Illinois. Eight thousand of these boys sent for the sample packages of corn and went to work.

The exhibit, as it was finally prepared and installed in the Palace of Agriculture (Pl. LXVIII), consisted of over 1,000 entries of ten ears each. The corn was of excellent quality and quite uniform in appearance and measurement. The prizes ranged from 50 cents to $500, and 1,250 exhibits received awards.

Eight thousand boys in a single State thoroughly aroused on the subject of improving corn! Think what power has been set in motion! And what possibilities for the accomplishment of good, especially when the interest thus aroused is extended to other matters, to the improvement of rural conditions generally!

DEVELOPMENT OF BOYS' CLUBS IN ILLINOIS.

And yet, the series of corn-growing contests just described is but one of a number in Illinois, all developed more or less directly under the auspices of the State College of Agriculture, the Illinois Farmers' Institute, and the county institute secretaries and county superintendents of schools. Seed has been furnished by the college and the farmers' institute, and contests have been arranged by the local authorities. Packages containing 500 grains of pure-bred corn were sent by the State Farmers' Institute to over 5,400 boys in 1904. The need of local associations through which the county superintendents and secretaries could work more effectually has led to the organization of clubs among the boys, usually by townships, with a county association of clubs. Probably a dozen different counties have started the club

movement, and several of these have strong and very active organizations. In Winnebago County the club membership was 425 in 1904, and in Johnson County it was 535. The State superintendent of farmers' institutes estimates that the total membership for the State is not less than 2,000.

The work of the boys' clubs is not confined to growing pure-bred corn, but also includes the testing of varieties of sugar beets, institute work, the judging of corn, visits to leading farms, and excursions to the State College of Agriculture. In thirty counties of Illinois last year one session of the farmers' institute was given over to the boys. In Winnebago County the Boys' Experiment Club has a regular place on the county institute programme (Pl. LXIX). Its members also meet at some of the best farms in the county to study the different crops, examine the buildings and live stock, and see the improved machinery in operation. Their experiments are something more than the growing of a small plat of corn, sugar beets (Pl. LXX, fig. 1), or soy beans; they include also the study of farm management, fertility, prevalence of barren stalks and smut—all of the conditions likely to affect materially the yield and quality of the crops grown. Note the points brought out by one of the boys in the corn-growing experiments in the following report to County Superintendent of Schools O. J. Kern, who has developed this work in Winnebago County:

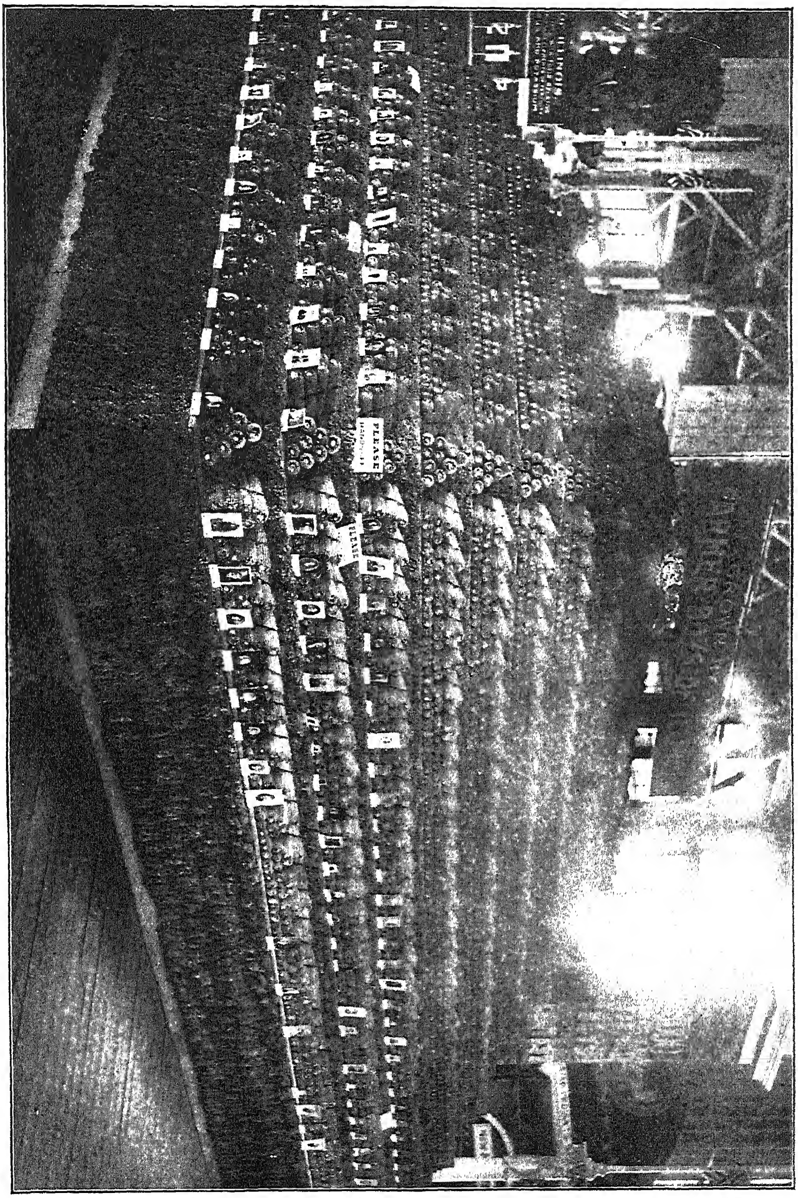
REPORT OF HARRY M'FARLAND.

My experimental corn was the Leaming corn. I planted my prize-growing corn on the 7th of May in a plat that contained 3 square rods. The soil was a black, sandy loam. The ground had garden truck on it last year, which left it in good condition for corn this year. The ground was plowed with a 16-inch plow at a depth of 6 inches. I planted my corn in rows 3 feet wide, the hills being 2 feet apart. The corn was up within 3 days and averaged 2 stalks to the hill. My corn had a good many suckers on, but very little smut. The corn averaged 12 feet tall, many stalks having 2 ears on. The work I put on my corn is as follows:

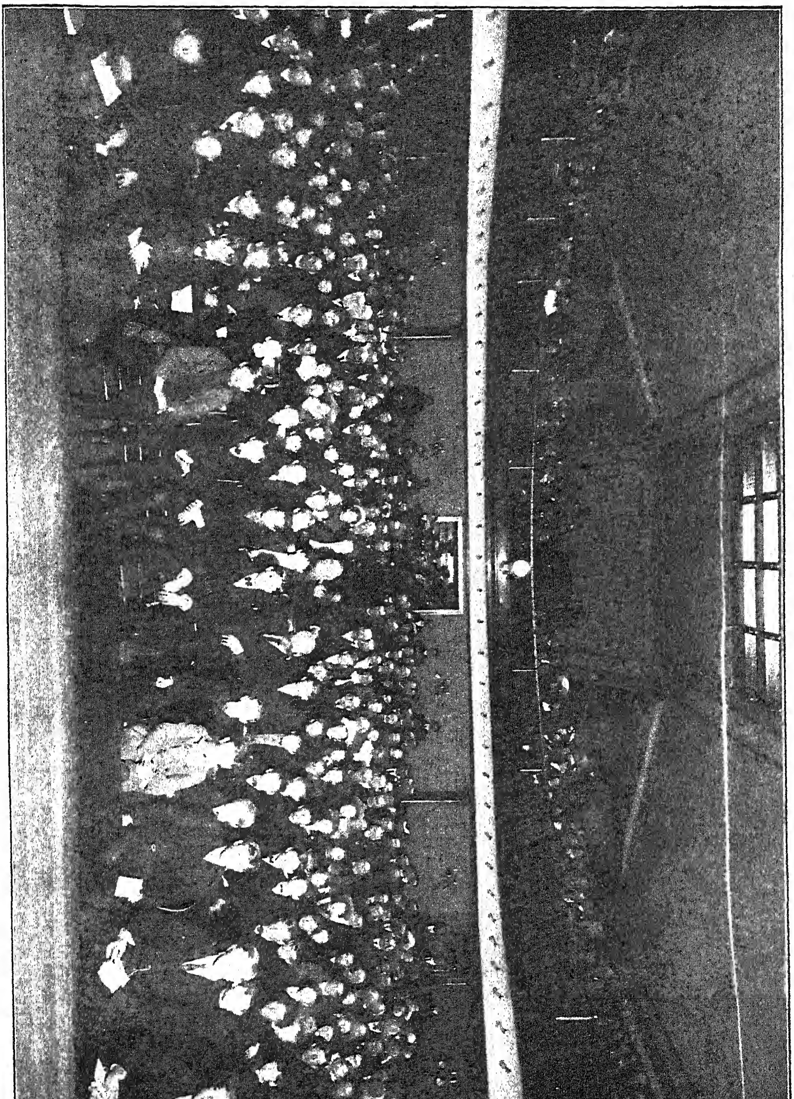
March 30, plowing one-half hour at 30 cents an hour	$0.15
May 6, harrowing one-half hour	.15
May 7, planting one-half hour	.15
May 20, cultivating 15 minutes	.05
June 3, hoeing corn one-half hour	.10
June 23, cultivating	.08
June 30, hoeing	.05
September 25, husking corn	.10
Cost of raising corn	.83

The total yield of corn was 2½ bushels. The value of the corn was $3. The gain was $2.17.

These Winnebago boys also have their lecture courses where, among other things, they learn about corn judging, from Professor Holden, of Iowa; stock feeding, from Professor Henry, of Wisconsin; birds and their benefit to the farmer, from Professor Dearborn, of the Field



BOYS' EXHIBIT OF CORN AT THE ST. LOUIS EXPOSITION.



BOYS' SESSION OF WINNEBAGO COUNTY FARMERS' INSTITUTE, ROCKFORD, ILL.

Columbian Museum; and the kind of country schools for country people, from Professor Davenport, of Illinois. They have access to excellent traveling school libraries, containing a liberal sprinkling of standard agricultural books, and the bulletins and other publications of the State experiment station and of the United States Department of Agriculture, and at commencement time receive diplomas or other certificates for the reading done during the year. They have been on several long excursions, including two to the Illinois College of Agriculture at Urbana, and one to the Iowa Agricultural College at Ames. This year they go to the Wisconsin College of Agriculture at Madison. At these agricultural institutions great pains is taken to show the boys the magnificent equipment in buildings, apparatus, and live stock and to take them over the field experiments. They come home talking intelligently of high-protein corn, draft horses, and market grades of beef cattle. Gradually but surely it grows upon them that it is not all of farming to drudge; that there is abundant opportunity to plan, study, investigate; that intelligence and culture are needed on the farm, and that the proper exercise of these qualities will yield as abundant returns in the country as in the city.

BOYS' CLUBS IN OTHER STATES.

Illinois is not alone in this forward movement. Iowa, Ohio, and Texas are keeping step with her in the boys' club work, and Indiana and New York have taken up the boys' institute work—the former with 15 meetings last year and the latter with 72. Indeed, it may be said that New York, with its 20,000 or more members of "Junior Naturalist clubs," leads all other States in the children's club movement. But these are nature-study clubs, quite different from agricultural clubs, and they are for girls as well as boys. There are also girls' clubs in these other States—Illinois, Iowa, Ohio, and Texas—but the limits of this article will not permit a discussion of girls' clubs or nature-study clubs.

In Ohio the boys' agricultural club movement was started about two years ago by the organization of a club in Springfield township, Clarke County, under the direction of Superintendent of Schools A. B. Graham. The work at this place does not differ materially from that in Illinois. It includes the testing of varieties of corn, garden vegetables, and flowers, and some work with insects, wild flowers, weeds, and soils. There are now 16 boys' agricultural clubs in 10 counties of Ohio, with a total membership of nearly 700. These have been organized under the auspices of the Ohio State University, which has sent out during the past year 1,012 packages of vegetable seeds, 565 packages of corn, and 1,261 packages of flower seeds, besides a large amount of litmus paper for use in testing the acidity of soils.

The Texas club movement was organized only a little over a year ago in connection with the Texas Farmers' Congress, but the membership of the Farmer Boys and Girls' League is now over 1,200. In Iowa the first club was organized by County Superintendent of Schools Cap E. Miller, at Sigourney, Keokuk County, in March, 1904. This club now has a membership of 335 boys, and its first year has been one of remarkable activity and progress. It has held several meetings, has made several excursions, including one to Ames and another to one of the largest ranches in the State, and it has conducted a series of school fairs that are worthy of brief description.

SCHOOL FAIRS.

Early last fall each of the 147 school districts in Keokuk County held a school fair, where the boys exhibited all sorts of fruits, vegetables, and farm crops which they had grown. The best and second best articles of each class were later entered at township fairs—one in each of the 16 townships in the county (Pl. LXX, fig. 2). In connection with each fair a programme was rendered consisting of talks and papers on corn, potatoes, peanuts, apples, and other fruits and crops, together with recitations and musical selections. All of the township fairs were attended by the county superintendent of schools and the president and the secretary of the boys' club of the county, the latter acting as judge of the agricultural exhibits. The first, second, and third prize articles from each township fair were then exhibited at a county school fair. This was held in the high school building at Sigourney, December 24, and was attended by over 1,000 people. The exhibit contained more than 3,000 articles and was probably the largest collection of varied agricultural products grown by boys ever brought together in this country. Professor Holden and Mr. Christie, of the Iowa Agricultural College, assisted in judging the agricultural products, and the former conducted a corn-judging school in which all of the boys took part. The programme rendered in connection with the fair included music, recitations, a debate on the subject "Resolved, That Corn is more Useful than Cotton," and a composition contest in which each graded school in the county was allowed one representative. The general theme of the compositions was "An Interesting Plant," each contestant presenting a paper on some particular plant. There were 10 compositions on corn, 3 on wheat, 3 on the tomato, and 1 or 2 on each of a dozen other common farm crops or flowers. Superintendent Cap E. Miller, who was the organizer and moving spirit in all this work, says of the fair:

It was the greatest educational meeting ever held in the county. The interest which it created has spread in its influence to all the work of our rural schools and has caused the farmers of our county to organize a farmers' institute. * * *

FIG. 1.—WINNEBAGO COUNTY, ILL., BOYS IN THEIR FIELD OF SUGAR BEETS.

FIG. 2.—RICHLAND TOWNSHIP SCHOOL FAIR IN KEOKUK COUNTY, IOWA.

The school-fair movement has been self-supporting. By means of a small admission fee all expenses of the fairs and of securing music, judges, and speakers were paid and a balance of about $50 was left in the club treasury. This is a matter of no little importance. A self-supporting enterprise, if worthy, commands greater respect than one which depends upon charity or private subscription for its support. And without doubt this is a worthy enterprise. Aside from the good which has come to its members through their activity in organizing and directing a remarkable series of educational meetings, much has been accomplished toward arousing enthusiasm for better, more wholesome country life, and toward laying the foundation for a broader educational movement along agricultural lines.

Laying the foundation is about all that can be hoped for in this direction during the next few years. It was forty years after the cornerstone of collegiate agricultural education in the United States was laid at the Michigan Agricultural College before the agricultural courses had been carried much above the basement line. But in the past four or five years the structure has gone up by leaps and bounds. The college courses have been developed and strengthened, the work of the experiment stations has been better systematized, and now greater attention is being given to extending the influence of these institutions beyond the bounds of the college campus. One of the direct results of this great forward movement in agricultural education, the aim of which is to extend agricultural education of some sort—formal or informal, advanced, intermediate, or elementary—to every grade of school attended by rural pupils, has been the organization of the boys' agricultural clubs. These clubs, though at present somewhat crude in their organization, are accomplishing much good, and are worthy of encouragement.

SUMMARY.

(1) Through their agricultural clubs the boys have been affected in many ways. Individually they have been led to observe more closely, to recognize good and bad qualities in the crops they have raised, and in the insects, fungi, and other things affecting these crops; they have met and learned to solve some of the problems in the improvement of crops; they have learned that improvement in one direction is not always, or even usually, accompanied by improvement in all directions; they have learned the value of labor, the cost of producing crops, and how to keep simple accounts with different crops; they have been encouraged to read good literature, and have learned some of the sources of agricultural literature; their views have been broadened by contact with others and by visiting institutions of learning, highly developed farms, and other points of interest, and, finally, the power

of taking the initiative has in many cases been strongly developed in them. As one of the direct results of the sugar-beet experiments, a few of the Illinois boys will raise sugar beets this year as a commercial venture. One sugar factory has already contracted with boys in Winnebago County to raise 20 acres of beets.

(2) Collectively the boys have learned the value of organized effort, of cooperation, and of compromise, and the social instinct has been developed in them—a matter of great importance in rural districts, where the isolated condition of the people has always been a great drawback to progress.

(3) The influence upon the communities at large, the parents as well as the children, has been wholesome. Beginning with an awakening of interest in one thing—better seed corn—the communities have rapidly extended their interest to other features of rural improvement, with the result that in the regions affected by the boys' agricultural club movement there has come about a general upward trend to the thoughts and activities of the people.

WORK OF THE BUREAU OF PLANT INDUSTRY IN MEETING THE RAVAGES OF THE BOLL WEEVIL AND SOME DISEASES OF COTTON.

By B. T. Galloway,
Chief of the Bureau of Plant Industry.

INTRODUCTION.

In January, 1904, a special appropriation of $250,000 was made for the purpose of meeting the ravages of the cotton boll weevil, studying diseases of cotton, and encouraging diversification of crops in the cotton-growing States. The Chief of the Bureau of Entomology and the Chief of the Bureau of Plant Industry prepared plans of work which were approved by the Secretary of Agriculture. The principal lines of work conducted by the Bureau of Entomology are set forth in another part of this Yearbook. In this paper is given a brief outline of the work accomplished by the Bureau of Plant Industry.

PLAN OF WORK.

The work of the Bureau of Plant Industry was planned and carried out according to the following outline:

(1) Plant breeding and selection work.

The development of improved early varieties of cotton by selection and hybridization.

(2) Investigations of tropical cottons.

Exploration and investigation in tropical America, the original home of both cotton and the weevil, with a view to discovering resistant varieties of cotton, or other means of overcoming or withstanding the attacks of the weevil.

(3) Diseases of cotton.

The investigation of diseases of cotton with the special view of obtaining healthier and stronger varieties and the elimination of causes of failure.

(4) Diversification farms.

Diversified farming, with the view of checking the weevil and growing other valuable crops in lieu of cotton.

(5) Cooperative demonstration farms.

Demonstration farms, in connection with which the more intelligent and progressive farmers in the weevil-infested districts were organized to cooperate with the Bureau in a systematic and concerted effort to demonstrate that cotton may be successfully and profitably grown in spite of the weevil.

(6) Distribution of early-maturing varieties of cotton.

The distribution to growers in the boll-weevil section of the seed of three early-maturing varieties of cotton in order to determine the value of such varieties in meeting boll-weevil conditions in comparison with the types ordinarily grown.

(7) Farmers' institute work.

The holding of farmers' institutes in cooperation with the Texas Agricultural and Mechanical College in order to bring about the adoption by farmers of more up-to-date cultural methods and the planting of diversified crops.

(1) PLANT-BREEDING AND SELECTION WORK.

The work of obtaining, by systematic and intelligent selection and breeding, varieties of cotton which will mature early enough to escape serious damage from the depredations of the weevil and varieties partially or wholly immune or resistant to its attacks, was conducted by Dr. Herbert J. Webber, physiologist in charge of the Laboratory of Plant Breeding of this Bureau. Valuable assistance was rendered by Prof. R. L. Bennett, of the Texas Agricultural Experiment Station. Most of the work was carried on in the weevil-infested districts of Texas, particularly at Terrell, where 170 acres were devoted exclusively to these experiments.

VARIETY TESTS.

One of the most important lines of work in starting investigations of this nature is the careful testing of all obtainable varieties to determine what sorts possess the most desirable characteristics, so that the plant breeder may choose the best foundation stocks for further improvement. In 1903 a number of different varieties were tested in special experimental plats. In 1904 over 100 different varieties, including 15 of foreign origin, were grown at Terrell, Hillsboro, and Calvert, Tex., mainly in half-acre plats, with some of the more promising ones in 5-acre fields, in order to furnish better facilities for making selections. The Texas Agricultural Experiment Station also tested a number of varieties in cooperation with the Bureau of Plant Industry.

The results of these experiments during the season of 1904 demonstrate the superior value of certain local strains of big-boll cottons, some of which proved to be fully equal to or better than such early varieties as the King and the Shine. In fact, all these tests have emphasized the good qualities of the group of Texas cottons generally known as the Stormproof type, represented by such sorts as the old Texas Stormproof and the newer and less known sorts, Triumph, Rowden, and Boykin. The fine staple, stormproof qualities, and big bolls of this group recommend them to growers. They all mature somewhat later than the King cotton, but the Triumph and Rowden varieties have given excellent results this year, and sufficient seed of the

Triumph has been secured for limited distribution. The Parker cotton, which, owing to its earliness and good lint qualities, has given good results and is now generally cultivated in boll-weevil districts, was first introduced into Texas by the Bureau of Plant Industry in 1902.

DEFECTS OF EXISTING EARLY VARIETIES.

The quality of early maturity in cotton for weevil-infested districts is a factor of the utmost importance, inasmuch as experience has shown that the early maturing bolls of the so-called first and second crops are the least likely to be seriously damaged by the weevil, whereas the later crop is almost sure to fail. But unfortunately such early varieties as have thus far been recommended for this purpose are inferior in quality and length of staple, have small bolls, and drop their lint readily, thereby rendering them especially liable to damage by storms.

BREEDING EARLY VARIETIES.

Earliness being the primary characteristic of importance in successful cultivation under boll-weevil conditions, and the existing varieties being inferior and unsatisfactory in many respects, it becomes desirable to discover or originate, if possible, new and better varieties possessing not only unusual earliness, but a fine, long staple, large bolls, productiveness, and ability to hold their lint. An examination of any variety of cotton in the field will demonstrate that plants differ greatly in the quality of earliness, some plants maturing much sooner than others, and usually it is possible to find certain individual plants which will transmit this quality.

NEW EARLY TYPES OF THE KING VARIETY.

Last year a considerable number of plants of the King cotton, which opened a week or more ahead of the main crop, were selected, and this year the progeny of these selected plants showed in many instances a net gain in earliness over the parent plant of as much as two weeks. All of these early plants were also selected for productiveness and for quality and length of staple, and this year the yield per plant was much better than on the parent plants last year. In 1903 scarcely a plant could be found with a 1⅛-inch staple, while the general average was only about seven-eighths inch. From the selected plants of last year a large number of plants were grown this year having a staple of 1⅛ inches and some of the plants had a staple of 1¼ inches. These experiments demonstrate clearly the possibility of combining with earliness the qualities of long staple and productiveness.

EARLY BIG-BOLL SELECTIONS.

Owing to the serious objections raised to the early varieties, such as the King, Parker, and Shine, on account of their small bolls, search was made through many fields of big-boll varieties for early types,

and as a result of tests of selections thus made three clearly distinct types representing certain characters thought to be desirable have been secured: (1) A large, vigorous, productive plant, with light-green foliage and very large bolls, earlier than other varieties with bolls equally large, and showing a tendency to continue setting fruit late in the season. (2) A rather small, slender plant, which fruits early but does not continue fruiting through the latter part of the season; easily picked, but likely to be beaten out during storms. (3) A plant similar to the second selection, but holding the cotton tightly in the boll, making it a little difficult to pick. This is an exceedingly promising type, as it is very early, has a large boll, and gives every evidence of being a cotton of great value for cultivation under Texas conditions.

MISCELLANEOUS SELECTIONS.

Fields of different varieties in various parts of Texas and adjoining States have been carefully examined and a large number of selections made of plants which give evidence of producing desirable characters. In 1903 selections of this kind were made from such varieties as Herndon, Jackson, Shine, Dixon, Jones, Hutchinson, and Texas Burr. The progeny of the Jones selections this year gave some exceedingly large and productive plants, with very fine large bolls, although rather late for Texas conditions. The selections from the other varieties mentioned proved to be disappointing and were for the most part discarded.

IMPROVING THE LINT OF EARLY VARIETIES BY HYBRIDIZATION.

A large number of experiments were made in crossing different varieties that give evidence of producing desirable combinations. A few of these hybrids were made in 1902 and 1903, some of which are sufficiently meritorious to deserve special mention. A hybrid of King, crossed with Allen Improved, gave plants fully as early as the first-mentioned variety grown in the same field and planted on the same date, and had a fine silky staple $1\frac{3}{8}$ inches long. A second hybrid of King, crossed with the Russell, gave a progeny nearly as early as King and very productive, but with larger bolls. Crosses of Allen Improved with Mattis have produced types of Upland cotton that are exceedingly productive and have a fine long staple. In addition to the foregoing a large number of hybrids were made of different varieties of Egyptian, Sea Island, and Upland cotton, but so far these have given little evidence of value.

PROLIFERATION, OR "GELATINIZATION."

It has been observed by Messrs. Hunter and Hinds, of the Bureau of Entomology, that in certain varieties of cotton, notably the King, as high as 41 per cent of the larvæ of the weevil fail to develop, being killed as the result of what they term the gelatinization of the tissue

in the young forms and squares. Further studies of this phenomenon, conducted by Mr. O. F. Cook, of the Bureau of Plant Industry, showed that this so-called "gelatinization," or proliferation, is the result of a very active growth of the soft tissues or column which in cotton surrounds the pistil and bears the stamens. The young forms, when punctured by the weevil, instead of falling, as occurs in many cases, continue to develop, and the tissue of the staminal tube, stimulated by the irritation of the puncture and the developing larva, forms a gall-like mass which surrounds the larva, and either smothers it or starves it to death. This tendency seems to be more marked in the early varieties, such as King, which would suggest the possibility of increasing this character by selection and also of developing strains which will destroy a much larger percentage or all of the larvæ in the forms or young squares.

BREEDING FOR SPARSE FOLIAGE AND HAIRINESS.

It has been found that varieties with sparse, open foliage which admits the direct rays of the sun, and varieties with hairy or woolly stems and leaves, which make it difficult for weevils to climb or move over them, escape damage in a greater degree than ordinary sorts, and special selections of this kind have been made with a view to breeding new sorts with these characters more strongly developed than in the varieties usually grown.

BREEDING EXPERIMENTS IN SECTIONS ADJACENT TO THE WEEVIL-INFESTED TERRITORY.

In addition to the work in Texas, experiments were conducted in Louisiana, Indian Territory, Mississippi, and western Tennessee with a view to establishing desirable varieties in those sections by the time the weevil reaches them. Experience has shown that varieties adapted to one section are likely to prove less desirable in other sections.

The alluvial region, bordering the Mississippi River, lying in Mississippi, Louisiana, Arkansas, and Tennessee, is distinct from all other cotton-growing regions of the United States, and is famous for its rich, productive soils and the quantity and quality of cotton produced. Practically all the varieties grown in this region, including the Peeler, Southern Hope, Allen Long-Staple, Sunflower, etc., are distinct from the varieties generally grown in other regions, and produce a longer and better staple, although late in season as compared with the King. If earlier varieties of these longer and finer stapled cottons are not secured before the arrival of the weevil in that region, their production will be almost entirely prevented. A careful study of these varieties has been made; several of the more promising types, such as the Black Rattler, Southern Hope, and Sunflower, were grown from seed selected in 1903, and further selections were made this year for continuing the improvement in 1905, with a view to securing greater earliness, productiveness, and length and fineness of staple.

The rank and vigorous growth of cotton in this important section renders it peculiarly liable to attack by the weevil, and only by developing the proper varieties in advance can this great industry be preserved.

OTHER FACTORS AFFECTING EARLINESS AND VALUE OF SEED.

Preliminary studies were made to determine whether cotton grown from seed obtained farther north matures earlier than that from seed of the same variety grown in the same section or farther south; whether the oil content of the seed is any indication of the vigor, earliness, productiveness, and quality of the lint of the cotton; also from what picking the best seed can be obtained. On all these matters definite information is lacking, but a series of experiments has been planned for next year which it is hoped will throw new light on them.

(2) INVESTIGATIONS OF TROPICAL COTTONS.

Early in 1902 Mr. O. F. Cook, while making investigations in eastern Guatemala, discovered that certain cottons grown there were free from the attacks of the boll weevil. For the purpose of discovering the cause of this apparent immunity, and, if practicable, securing seed of the cottons, Mr. Cook returned to Guatemala early in the spring of 1904. This visit resulted in the discovery of a weevil-eating ant. Considerable numbers of this ant, called by the Indians "kelep," were found collecting nectar on almost every plant. A careful study was made of the ant and its habits and a large number of colonies were introduced into Texas. Having gone thus far with the investigations, the continuation of the work was turned over to the Bureau of Entomology.

PROLIFERATION, OR "GELATINIZATION."

While engaged in securing the weevil-eating ant in Guatemala and establishing it in Texas Mr. Cook made a special study of the weevil-resistant qualities of Guatemalan and Texan varieties of cotton, particularly the so-called "gelatinization" mentioned in connection with the plant-breeding work of Doctor Webber, and the information thus obtained may prove of value in subsequent experiments along this line.

(3) DISEASES OF COTTON.

A careful study of diseases of cotton was undertaken, particularly of root-rot, which causes an annual loss to the cotton growers of Texas of from $2,000,000 to $3,000,000. The work in Texas was assigned to Mr. C. L. Shear, a pathologist of the Bureau of Plant Industry, who, besides making laboratory studies of the parasite which causes the disease, has thoroughly investigated the effect on root-rot and other cotton diseases of methods of cultivation, rotation of crops, and

different soils, fertilizers, and fungicides. No means of entirely controlling root-rot has as yet been found, but observation and experience indicate that crops which cover the ground, such as sorghum sown broadcast, wheat, oats, and millet, followed by deep plowing, are most effective in eradicating the disease. A large number of plants were selected from standard varieties in infected districts with a view to securing strains resistant to disease. Considerable work was also done by Mr. Shear in cooperation with the Texas Agricultural College and Experiment Station on the so-called "cotton rust," and it is hoped that good results will be obtained along this line next year.

The work of studying diseases of cotton in the eastern portion of the cotton belt was assigned to Mr. W. A. Orton, a pathologist of the Bureau of Plant Industry. Special attention was given to diseases of the celebrated Sea Island cotton in southern Georgia and northern Florida, such as the wilt, root-knot, black-arm, rust, and anthracnose. Similar studies were also made of diseases of Upland cottons of this region, including the causes of the shedding of bolls. Numerous selections were made of immune plants with a view to breeding resistant strains, and much valuable information was obtained with respect to the diseases studied and promising methods of dealing with them, which will be tested and the results published later.

(4) DIVERSIFICATION FARMS.

Realizing the importance of introducing other crops and demonstrating the feasibility of growing them with profit in the region where heretofore cotton has been the sole money crop, the Bureau of Plant Industry planned to establish a series of diversification farms in the districts already infested with the weevil or in danger of infestation in the near future. This work was placed under the immediate direction of Prof. W. J. Spillman, the Agrostologist of the Bureau, and 24 farms, organized in cooperation with the various State experiment stations, were located as follows: Columbia and Moore, S. C.; Hogansville and Commerce, Ga.; Talladega, Uniontown, and Huntsville, Ala.; Wiggins, Ridgeland, and Courtland, Miss.; Natchitoches, La.; Atlanta, Marshall, Groesbeck, Crockett, Bellville, Columbus, Lockhart, Arlington, Chillicothe, Boerne, Corpus Christi, Eastland, and Dallas, Tex.

The general method of procedure in establishing these farms was to seek progressive farmers who were willing to cooperate and whose farms were advantageously located for the purpose. Then, after a careful study of the conditions of the locality, a cropping system for each farm was laid out and advice given concerning the crops to grow, the area to be devoted to each, and the methods of preparing the soil, seeding, cultivating, harvesting, utilizing, and marketing each crop. In general, the work of these farms has been so planned as to encourage

truck farming and various types of stock farming, such as hog raising, dairying, and beef production. The cropping systems adopted in each case were devised with a view to increasing soil fertility, while at the same time rendering the farm more profitable than would be possible under a single-crop cotton-growing system. Arrangements were made for keeping careful records of the work on each farm, with a view to publishing for the benefit of others the details of the methods pursued and the results achieved.

It was also a part of the plan to hold farmers' institutes in connection with the farms, in cooperation with the State authorities, for the purpose of explaining to as many farmers as possible the methods adopted, and then showing them over the farms so that they might see the results. Unfortunately, it was possible to hold but one meeting of this character during the season, this being in connection with the farm at Uniontown, Ala., where at least a thousand farmers were in attendance.

Owing to the lateness of the season when funds became available for this work and the time required for the organization of the farms, only 4 were ready to plant crops in the spring of 1904. The remaining 20 farms were organized in time for the planting of crops in the autumn of 1904.

On the 4 farms mentioned the results have been most satisfactory and encouraging. On Diversification Farm No. 1, at Columbia, S. C., was grown a variety of crops, such as corn, peas, potatoes, oats, alfalfa, peanuts, cabbages, and tomatoes, besides cotton, cattle, and goats, and about 40 head of hogs for the market. The cropping system on the diversification farm at Uniontown, Ala., was planned with special reference to the production of pork. In addition to 14 acres of old Bermuda pasture, there were planted 15 acres of alfalfa, about 4 acres of sorghum, 10 acres of cotton, and 35 acres of corn. Peas were sown in a portion of the corn in midsummer. As the result of the first season's operations on this farm 20 pigs were sold in December, and 56 fat hogs, averaging over 200 pounds each, were ready for the butcher. Nine brood sows and 81 pigs were left, besides the product of 10 acres of cotton. The owner of this farm states that, considering the acreage utilized, it has been the most profitable farming he has ever done. The owner of the farm at Wiggins, Miss., in the sandy lands of the Piney Woods region, states that all the crops grown, including corn, sugar cane, potatoes, cassava, and chufas, did well; that the methods employed have demonstrated the profitableness of diversified farming in that region; that a truck growers' association has been formed, and that the shipments from that locality this season will be large. The work on the diversification farm at Arlington, Tex., was also very satisfactory, notwithstanding the late date at which it was organized.

ALFALFA.

Much has been done to encourage the culture of alfalfa as a hay and pasture plant and as a soil renovator. Its culture is rapidly spreading on the alluvial soils of Louisiana and Mississippi and on the black prairie and alluvial soils of Texas, Alabama, and northeastern Mississippi. In these sections the yield frequently reaches 5 or 6 tons per acre, and is generally over 3 tons. There is a good market for this hay, and the income from the crop is greater than that from cotton, with much less labor. When used for hog pasture in conjunction with one-fourth of a full grain ration, it easily produces 1,000 pounds live weight of hogs per acre in a season. An instance is reported from the Red River Valley in Louisiana in which $385 was received from dressed pork produced from 2¼ acres of alfalfa and 1 acre of sorghum, with no other feed—an income of $110 per acre, with far less labor than would have been required for the production of a crop of cotton on the same land.

FORAGE CROPS AND TRUCK FARMING.

Considerable attention has also been given to the production of other forage crops in the cotton-growing region, such as sorghum, cowpeas, cassava, velvet beans, Mexican clover, dwarf milo maize, and winter barley; but perhaps the most promising industry for the South is truck farming. Conditions there are peculiarly suited to this industry, and a ready market exists in the cities of both the North and the South. Marked success has been attained in many regions, particularly with potatoes, onions, and tomatoes. One onion grower received this season over $800 per acre for his crop. In another instance a farmer in northeast Texas received $118 per acre for his potato crop, and then produced a bale of cotton per acre on the same ground later in the season.

It is safe to say that no single branch of agriculture in the South to-day presents so many opportunities for money making as are to be found in diversified farming, and particularly in truck growing.

(5) COOPERATIVE DEMONSTRATION FARMS.

In order to demonstrate in the widest and clearest possible manner that cotton can be successfully and profitably grown despite the presence of the weevil, by means of better cultural methods, the use of early-maturing varieties of cotton, and suitable fertilizers, the Bureau of Plant Industry organized, in cooperation with the intelligent and progressive farmers of Texas and Louisiana, something over 7,000 cooperative demonstration farms, their owners pledging themselves to cultivate a plat of 10 acres, more or less, of cotton in accordance with instructions from the Bureau and to report results. The cooperation of these farmers was secured and the work was organized and conducted under the supervision of Dr. S. A. Knapp, special agent,

with headquarters at Houston, Tex. The territory actually worked under the cooperative plan extends from Spofford, Tex., to Monroe, La., a distance of 600 miles east and west, and from Galveston to Channing, Tex., nearly 600 miles north and south. During the season more than a thousand farmers' meetings were held at which addresses were made by Doctor Knapp or his assistants.

The plan followed on the cooperative farms was designed to accomplish two things: (1) To keep the weevil in check by the fall burning of stalks, as set forth by the Bureau of Entomology; and (2) to force the crop to early maturity before the weevils have a chance to multiply and cover the field in sufficient numbers to cause serious damage, this result being attained by systematic and intelligent selection of seed of early varieties, by early planting, thorough preparation of the soil, the use of proper fertilizers, wide spacing, frequent cultivation continued late into the season, and the control of plant growth by barring off and topping when necessary.

RESULTS.

That this method of growing cotton in weevil-infested districts was highly successful is amply attested by the reports of Doctor Knapp and his assistants in the field, as well as by hundreds of the cooperating farmers themselves. With few exceptions the average yield per acre on the demonstration farms was from 50 to 100 per cent greater than on neighboring farms this year, or on the same farms in former years when cultivated under the old system.

As an illustration of actual results obtained, the following cases are cited:

Maj. J. S. Grinnan, Terrell, Tex., planted 100 acres of Rowden cotton, using 100 pounds each of mixed cotton-seed meal and phosphate per acre, and averaged over a bale to the acre on land which for the past ten years did not exceed one-fifth bale per acre.

G. W. Alexander, Langston, La., planted 20 acres of Russell Big-Boll cotton on sandy land, fertilized with 250 pounds (one-third cotton-seed meal and two-thirds acid phosphate) per acre, the plants spaced 4 feet between rows and 18 to 24 inches in the row, and averaged 700 pounds of lint per acre.

Wilson Bell, Luling, Tex., planted 7 acres of Mebane cotton on black sandy land, and averaged 412 pounds of lint per acre.

J. T. Park, Madisonville, Tex., planted 4 acres of King's Improved cotton on post-oak upland, using 24 loads of stable and cow-pen manure, spacing 4 feet between rows and 2 feet in the row, and averaged 435 pounds of lint per acre, where last year he made but 30 pounds of lint per acre.

E. Courtney, Mount Lebanon, La., planted 1 acre of Bass cotton, using 300 pounds of acid phosphate and 100 pounds of cotton-seed meal per acre, spacing 4 feet between rows and 3 feet in the row,

and gathered 2,450 pounds of seed cotton, as compared with 1,000 pounds of seed cotton per acre on similar adjacent lands under the usual cultivation.

W. A. Castleberry, Minden, La., planted 6 acres of King's Improved cotton, spacing 6 feet between the rows and about 15 inches in the row, and made 665 pounds of lint per acre.

W. M. White, Douglas, La., planted 2 acres of King's Improved cotton, spacing 5 feet between the rows and 18 to 20 inches in the row, and made 711 pounds of lint per acre.

W. C. Porter, Terrell, Tex., planted 400 acres of King, Rowden, and Gibson cotton on land mostly sandy loam, spacing 5 feet between rows and 20 inches in the row, and made 265 bales. He realized from the sale of 245 bales and seed (20 bales and seed yet unsold) $13,475. His total expenses, including fertilizer, hired help, feed of work stock, estimated wear of tools, picking, etc., were $6,475, leaving a net profit for the year from cotton alone of over $7,000.

The foregoing will serve as illustrations of what hundreds of other farmers have accomplished the past season.

(6) DISTRIBUTION OF EARLY-MATURING VARIETIES OF COTTON.

Under the direction of the Secretary of Agriculture 10,000 bushels of seed of three early-maturing varieties of cotton were distributed through the boll-weevil section. The varieties distributed were the King, Parker, and Shine. These varieties have all been very fully described in publications of the Bureau of Plant Industry. The seed was distributed through Members of Congress in each district, not less than 5 bushels being sent to any one individual. At the close of the season a circular was sent to each grower who had received seed, requesting a statement of the results obtained.

The primary object of the work was to determine the value of these early-maturing sorts as compared with the common types grown. The reports on the different varieties distributed are divided into two classes, according to the character of the soil on which the results were obtained. Class 1 includes reports from the dark, heavy soils, while class 2 includes those from light grades of soils. There were 657 reports on the King cotton, and these show that this variety matured nine days earlier than the common cotton compared with it. It yielded an average of 85 pounds more seed cotton per acre than the common cotton. The yield was greater on the dark than on the light soils, both in the case of the King and the common seed. The percentage of King cotton damaged by the boll weevil was less than that of common cotton, and the percentage of damage from the boll weevil was reported a little less on dark than on light soils.

There were 552 reports on Parker cotton which show that this variety was a little earlier than the common cotton. It produced an average of 24 pounds more seed cotton per acre than common seed.

One hundred and eighty-one farmers reported on the Shine cotton, and an average of their reports showed that it required seven days less to mature than common cotton. It produced 84 pounds more seed cotton per acre than common seed.

Of the three varieties distributed, the King gave the greatest average yield. Each of the three varieties gave a better yield than common varieties grown in comparison with it, and of these the King cotton gave the greatest increase, while the Parker gave the least.

(7) FARMERS' INSTITUTE WORK.

As a part of the work conducted by this Bureau, cooperation was effected with President Houston, of the Texas Agricultural and Mechanical College, with a view to aiding in the farmers' institutes conducted by that institution. The main object of the work was to acquaint the farmers with the most approved methods of cotton culture in order to aid them in making a crop in spite of the weevil; in short, to induce them, if practicable, to adopt more up-to-date methods and to diversify their crops as far as possible.

The localities which seemed to be most in need of the services of the institutes were carefully selected throughout the State with a view to reaching the greatest number of people. Every device for giving out notices of the meetings and for securing a large attendance was employed. Where institutes had already been organized, the services of their members were enlisted, personal letters were written to county officials, editors of county papers, and prominent and wide-awake farmers, and programmes announcing dates and places of meetings and lists of speakers and subjects were issued. The railroads and the press cooperated fully in this work and thereby made it much more effective. The lecturers comprised the director of the institute, Prof. J. W. Carson; practically all the members of the agricultural department of the college; and a number of special agents and other officers of the Department of Agriculture. In addition, there were volunteer speakers, including industrial agents of railways and various practical farmers, where such could be obtained. Approximately 70 institutes were organized between September 1, 1903, and September 1, 1904. Some of the more important subjects discussed at these institutes were: The advantage of organization; Cotton—varieties, culture, selection of seed; Corn—varieties, culture, selection of seed; Forage crops—alfalfa, oats; Irish potatoes—growing, handling, marketing; Hog raising in the South; Foods and feeding; Cotton insect pests; The care and management of soils; How to maintain soil fertility; Commercial orcharding; Small fruits; Fruit and truck growing; Commercial fertilizers—their nature and use; Small canning factories for home use; Our agricultural college—what it is doing for the farmer; What the experiment stations are doing; Farming without rain; Creameries for Texas.

SOME BENEFITS THE FARMER MAY DERIVE FROM GAME PROTECTION.

By T. S. PALMER,
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INTRODUCTION.

Game protection in the United States has been developed along somewhat broader lines than in other countries. Its object is not solely to preserve a few animals and birds to furnish sport for a limited class, but to protect and increase useful species for the benefit of the people in general. It preserves not only game animals and game birds, but also birds of song and plumage and those which are beneficial as scavengers or as destroyers of injurious insects and noxious weeds. To a certain extent, also, it restricts the increase of injurious species and prevents the introduction of animals and birds which are likely to become pests. While receiving the support of the sportsman, it benefits the farmer by increasing the species which are useful to him in protecting him from the inroads of those which may injure his crops, and it furthermore commands the interest of that ever-increasing class of persons who find health and recreation in observing or studying nature.

RELATION OF THE FARMER TO THE GAME LAWS.

The earliest game laws of the Colonies, among which may be mentioned the acts passed by Connecticut in 1677, by Virginia in 1699, and by New York in 1705, were limited to deer. In the beginning of the eighteenth century protection was extended to birds, although at first to only a few species and for short periods of the year. Thus, a statute enacted in New York in 1709, one of the first measures of the kind, provided close seasons only for deer, turkeys, heath hens, partridges or ruffed grouse, and quail, and one passed in 1791 close seasons for heath hens, partridges or ruffed grouse, quail, and woodcock.

Special laws for the protection of insectivorous birds, the birds of most interest to the farmer, were apparently not considered necessary until the middle of the nineteenth century. Such laws were first enacted by Connecticut and New Jersey in 1850, Vermont in 1851, Pennsylvania in 1853–1858, Massachusetts in 1855, and Ohio in 1857. West Virginia in 1869 seems to have been the first State to extend

protection to all birds except a few injurious species.[a] Subsequently more attention was paid to the question of enforcement and the work was placed in charge of special State officers known as game wardens or commissioners. In 1878 New Hampshire established a board of fish and game commissioners and in the following year Delaware granted a charter to its State Game Protective Association, which was placed in charge of warden work. In 1880 Maine extended the jurisdiction of its commission of inland fisheries to include protection of game, and in 1886 Massachusetts and Ohio followed Maine's example. In 1887 Michigan and Minnesota each authorized the appointment of a State warden, and in 1888 New York established the office of chief game and fish protector. Other States followed in quick succession until at the present time thirty-five have State game commissions or wardens.

Simultaneously with the development of legislation for the protection of game occurred another development intended to afford greater protection to landowners and tenants. This legislation took the form of penalties incorporated in the game laws for certain forms of trespass and enforced by game wardens as well as local peace officers. As early as the latter part of the eighteenth century the game laws of North Carolina contained provisions prohibiting hunting on another person's land without permission, and similar laws were subsequently enacted in Virginia, Maryland, Tennessee, and other States. In some of these States hunters are now required to secure written permission from the owners of the lands on which they wish to hunt, and in the West during the last ten years trespass provisions have been still further extended to cover hunting along highways. The addition of these features to the game laws has made it easier to prevent and to punish trespass and has given landowners protection which they never enjoyed under ordinary trespass statutes.

Recent years have witnessed a change in sentiment in regard to game laws. The idea formerly prevalent that game belonged absolutely to the person who captured it is fast giving way to the principle that it belongs to the State and may be captured and held in possession only under such conditions as the State permits. Recognition of this principle, which has been incorporated in the laws of a number of States, and has been affirmed by several of the highest courts, including the

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[a] It is interesting to note that the same steps may be traced in the development of the English game laws, but that progress was much slower. Deer were protected by the Charter of Forests granted by King John in 1215; pheasants and partridges by an act prohibiting netting or snaring without permission of the landowner passed in 1494, in the reign of Henry VII; and wild fowl by a statute passed in 1533, in the reign of Henry VIII. Nongame birds were not protected until 1880, and even now have only a close season, usually five months or less (varying according to the county), between March 1 and August 1. In the United States nongame birds are protected throughout the year.

Supreme Court of the United States, is now becoming general and is necessary for a clear understanding of the complexities of modern game legislation.

It should not be assumed, however, that because the State owns the game and fixes the seasons and methods of its capture that the farmers' rights have been ignored. On the contrary he still retains practically complete control over the game on his premises, since he can to a certain extent fix the conditions under which it shall be taken and has absolute right to say whether or not it shall be hunted at all. To prevent the losses which might be caused by undue increase of certain species through protection, landowners are often allowed the privilege of killing birds or other small game whenever found destroying crops, and in Maine, Vermont, and Massachusetts persons who have sustained losses through depredations of deer may be reimbursed by the commissioners of fisheries and game if their claims are found to be reasonable and based on actual damages.

GAME PROTECTION AS A CHECK ON HUNTING.

Rapid increase in population, accompanied by great improvements in firearms and a greatly decreased cost of rifles, guns, and ammunition, has resulted in an enormous increase in the number of persons who hunt. In the absence of complete statistics it is difficult to ascertain how great this increase has been during recent years, but a few figures will emphasize the present number. Several States now require both residents and nonresidents to secure licenses before hunting. The returns for 1903 show that in ten of the States which have such a system, namely, Colorado, Idaho, Illinois, Michigan, Minnesota, Nebraska, North Dakota, Washington, Wisconsin, and Wyoming, the total number of licensed hunters was 261,241. The largest numbers in any of these States were 78,823 in Wisconsin and 95,250 in Illinois, and the average in all was 26,124. These figures are still below the actual number, as it is not likely that every hunter obtained the required license; and even if such were the case, licenses are not needed by residents in Minnesota, or by anyone in Michigan or Wyoming hunting birds and other small game, or in Nebraska or Wyoming by any person hunting in the county in which he resides.

The destruction which an army of 26,000 hunters roaming at will over any State might bring about is beyond computation. In the absence of game laws these persons would be free to hunt in every month of the year, to shoot game throughout the breeding season, to kill song and insectivorous birds for food or sport, to break up nests and destroy eggs, and to net or trap desirable species to the point of extermination. The tendency of the game laws has been constantly to restrict hunting, to shorten open seasons (in the case of quail to two or three months, except in the South), to prohibit all shooting during the spring and early summer, to protect nongame birds throughout

the year, and to abolish netting and trapping entirely. Thus, the farmer is saved the annoyance of hunters tramping through his growing crops and killing the birds which protect his orchards and gardens, or trapping the more valuable species which nest about his premises.

PROTECTION OF PROPERTY.

Still further protection to his property is afforded the farmer by modern game laws. Under the common law and under the statutes of many of the States the landowner has the right to eject trespassers from his premises and to collect damages for any injury which they may have done to his property. In the case of hunting, however, certain conditions exist which render it difficult for the rural landowner to obtain the full benefit of the trespass law. If his property embraces several hundred acres, or if much of it is wooded or rolling land, it is by no means easy to patrol the place or to apprehend persons in the act of trespassing. Moreover, unless the land is under cultivation, inclosed, or properly posted, it may be difficult to collect any damages for shooting on the premises. Even if these obstacles do not exist the landowner often prefers to put up with more or less annoyance or loss rather than incur the ill-will of his neighbors by enforcing the trespass laws against them; not only because such action on his part would disturb friendly and pleasant relations, but because in some sections retaliation would probably follow in the form of loss of poultry, hogs, or sheep, a hamstrung horse, or even a burned barn. Recently a still more aggravated form of trespass has developed in some States which have received a large influx of immigrants from southern Europe. These newcomers, ignorant both of the language and of the law, frequently mistake liberty for license, and, free from the restraints to which they were accustomed in their own country, imagine that they can hunt birds of all kinds without restriction as to place or season. When thus engaged they throw down rail fences, trample grain, steal fruit, or commit similar depredations, and meet remonstrance or interference on the part of the owner with stolid indifference or a resentment which occasionally leads to personal encounter. Conditions like these would be intolerable were remedies not provided outside of the trespass law.

Recognizing the importance of affording protection to the landowner as well as to the game, the legislatures of many States have incorporated in the game laws special provisions for the protection of farms. In a dozen or more States it is made a criminal offense, punishable by a fine of from \$5 to \$25 or more, to hunt on inclosed or posted lands. It is also an offense in Indiana, Ohio, and Tennessee, and in some of the counties of North Carolina and Virginia, to hunt without written permission of the landowner; in Minnesota, North Dakota, Oregon, and Wisconsin to enter standing grain; in Texas to

enter or hunt on any inclosed land comprising less than 2,000 acres in one inclosure, and in West Virginia to discharge firearms on another person's land within gunshot of an occupied dwelling even after securing permission to hunt on the premises.

Shooting from the highway is a form of trespass which is often as annoying as it is difficult to control. A landowner who has no means of redress against irresponsible hunters killing game along the road adjoining his place or shooting over his fences and perhaps injuring his stock or poultry is not in a position to secure complete protection for his premises. So troublesome has this form of trespass become, particularly in some of the Western States, that special penalties have been provided for shooting along the road. When the nature of the highway is considered such legislation is not unreasonable. Sportsmen sometimes assume that a highway is public property, and if shooting is done in the open season there is no trespass. But unless legal provisions declare otherwise, public interest in the highway is limited to a specific purpose, that of travel, and all other rights in it belong to the landowners upon whose property it lies. The wisdom of special legislation to prevent this form of trespass has been recognized by several States, and provisions for the purpose, incorporated in the game laws, were adopted by Kansas in 1886, by Iowa in 1897, by Colorado in 1899, by Nebraska and West Virginia in 1901, and by Oklahoma in 1903.

The enforcement of these and other provisions of the game laws is delegated to game wardens and their deputies, to whom complaints may be made or who may be called upon to apprehend and prosecute offenders. In Wisconsin, in the open season of 1904, 90 salaried wardens and deputies were on duty, and in Illinois 114. It can readily be seen that with the extension of the telephone system into rural districts a constabulary of this kind properly organized and supervised, and devoting its entire time to the work, may afford protection far beyond the power of regular peace officers. In some parts of the States mentioned it is only necessary to notify the nearest warden by telephone of the fact of hunting on the premises, or of the name of the trespasser, and the officer will apprehend and prosecute the offender without annoyance or loss of time on the part of the landowner.

PROTECTION OF USEFUL BIRDS.

Weeds and injurious insects cost the farmers of the United States millions of dollars annually, both in direct losses and in expenditures for labor and materials necessary to protect their crops. Anything which tends to reduce the number of weeds or to check the ravages of injurious insects is therefore a direct benefit. Among the most potent natural agents in checking such losses are insectivorous and seed-eating

birds, and the importance of their preservation, while difficult to measure in dollars and cents, is self-evident, since it may mean the difference between large profits and heavy losses. The food habits of the more important common birds are discussed at length in the publications of the Biological Survey, and it will be sufficient here to recall merely a few examples mentioned by Prof. F. E. L. Beal[a] to show the vast quantities of insects and weeds destroyed by certain species under favorable circumstances. The common meadowlark is perhaps one of the most valuable of all birds, for more than half of its food consists of harmful insects and the vegetable portion of its fare is largely made up of seeds of injurious weeds. The nighthawk, which is almost exclusively insectivorous and usually supposed to feed on insects which fly some distance above the ground, has been shown to feed on grasshoppers, as many as 60 being found in a single stomach. A single stomach of the yellow-billed cuckoo has been found to contain 217 fall webworms and another 250 American tent caterpillars. Two flickers were each found to have eaten 3,000 ants and a third 5,000.

Dr. S. D. Judd[b] has called attention to the quantities of insects captured by birds to feed their young. In the case of the kingbird one-half the stomach contents of 14 nestlings consisted of crickets and grasshoppers. In feeding a brood of three young wrens about three-fourths grown the mother was observed to make 110 visits to the nest in a period of less than eight hours, and in this time she fed the nestlings 178 insects and spiders, among them being 14 grasshoppers, 32 May flies, 54 caterpillars, and 13 spiders.

Even more striking examples may be found in the case of some of the seed-eating birds. From a study of the tree sparrow made some years ago in Iowa, Professor Beal estimated that the quantity of weed seed destroyed by these birds in the State in a single season amounted to 875 tons. In examining stomachs of doves he found one containing 7,500 seeds of the yellow wood sorrel (*Oxalis stricta*) and another 9,200 miscellaneous seeds, chiefly weeds. The total quantity of weed seeds destroyed by such birds as these in the course of a season is almost beyond computation. Under modern game laws complete protection throughout the year is extended to nongame birds. In the case of the dove, however, which is often considered a game bird, an open season for hunting is provided in a few States, although the tendency is to remove it from the game list on account of its importance as a weed destroyer.

PROTECTION AGAINST INTRODUCTION OF INJURIOUS SPECIES.

The benefits of protection already mentioned are evident, but the advantages of preventing the losses which may result from thoughtless or ill-advised introduction of injurious species are less obvious.

[a] Farmers' Bulletin 54, Common Birds in Relation to Agriculture, revised ed. 1904.

[b] Yearbook of the Department of Agriculture for 1900, pp. 415–426.

It is impossible to estimate in advance what the damage will be, but the history of the rabbit in Australia, the mongoose in Jamaica and Hawaii, the English sparrow in the United States, and a number of other species in Australia and New Zealand shows the dangers which exist in permitting experiments in acclimatization of animals and birds to be made without restriction. In all such cases it is the farmer who suffers directly by the destruction of his crops or indirectly by insect pests which increase as a result of the diminution of their natural enemies.

In recognition of this fact Congress, in giving the Department of Agriculture jurisdiction over matters pertaining to game protection, also prohibited the importation of injurious mammals and birds, and intrusted to the Secretary of Agriculture the duty of determining what species were likely to become injurious and how they could be prevented from gaining a foothold in this country. Under authority of this act the Secretary of Agriculture, with the cooperation of the Secretary of the Treasury, has carried into effect a system of permits for the entry of nearly all wild animals and birds brought into the United States, with special inspection when necessary. Every person who wishes to import wild birds alive must first obtain authorization from the Department of Agriculture. While the Cape Colony and some of the States of Australia have similar restrictions on acclimatization, no other government in the world has gone so far or extended protection over such an area of country in the effort to protect itself from the evils attendant upon ill-advised acclimatization.

Several of the States cooperate in and supplement this work. The State board of horticulture of California, by its organic act passed in 1883, was authorized among other things to make regulations to prevent the spread of fruit pests. In 1894 the board adopted a regulation prohibiting the importation into the State of animals or birds detrimental to fruit or fruit trees, and requiring the destruction of any inadvertently brought in. Maine, in 1899, enacted a law prohibiting the introduction of wild birds or animals of any kind into the State, except upon written permission of the commissioners of inland fisheries and game. Colorado in the same year established a requirement that importers should obtain certificates from the State game and fish commissioner before bringing game or fish into the State for propagation.

FINANCIAL BENEFITS.

DIRECT BENEFITS.

That the game on the farm has a money value is not always recognized, or, if so, seldom receives due consideration. Rabbits, quail, grouse, and other game taken during the open season afford not only an important addition to the table, but may save considerable expenditure for other meat. The value of this game is, therefore, not merely

the small amount it would bring in cash or in provisions at the country store, but rather what it saves in the cost of other meats; and it is greatly to the advantage of the landowner to utilize the game upon his own table instead of disposing of it at the store. It is true that without game laws a small number of rabbits, quail, or other resident game might be retained on a farm of sufficient extent. But on many farms the stock would soon be depleted, and in the case of migratory game adequate protection both northward and southward is necessary to enable anyone to secure birds in abundance, and this protection can be had only through the medium of State laws.

Under some circumstances the game on the farm may be made to yield a higher cash return by utilizing it in other ways than for market or for the table. In the case of quail, dead birds are worth from $1 to $3 a dozen, but live birds for propagating purposes may easily be sold at $5 a dozen. In fact, in 1904 the demand for live quail was so great that some sales were effected at $10 a dozen, and eve at this rate the supply was entirely inadequate. With the increasing scarcity of game it is more than proba le that the demand for birds for restocking covers will show a steady increase. At present a supply of from 100,000 to 200,000 a year would probably be requir d to meet needs for this purpose, and there is no apparent reason why this demand should not greatly increase in the future. Still better prices may be obtained by the farmer if instead of selling the dead game for market or disposing of the live birds for propagating purposes he will lease hunting privileges on his farm. These privileges may be rented by the day or by the season, and may be accompanied with charges for board and lodging, the use of a team, or the time of a boy to act as guide, and will thus net a very profitable return. If the number of birds killed be limited, to prevent the stock from being permanently reduced, such leases may be continued almost indefinitely.

INDIRECT BENEFITS.

Reference has just been made to the demand for game for propagation. With the increase in private preserves and game protective associations it is probable that such demands will be greatly extended in the future, not only in the case of quail, but of other birds as well. The raising of game birds in captivity has not yet been reduced to a practical basis in this country, except in the case of pheasants, but that such will be the result of experiments now being made is scarcely open to question. In a few cases quail, prairie chickens, mallards, wood ducks, and wild geese have been satisfactorily propagated, and during the past season, in at least one instance, ruffed grouse were successfully raised in captivity. It is claimed by those who have experimented along this line that prairie chickens and pheasants can be raised with no more trouble or loss than turkeys. When methods

have been perfected so that some certainty will attend such efforts the members of the farmer's family may find in this branch of game protection a new and profitable source of income. With pheasants ranging in price from $3 to $15 or $20 per pair and wood ducks from $15 to $25 per pair it would seem that even with the special care required better returns might be received than from ordinary investments in poultry raising.

Indirectly the systematic protection of game and fish may be the means of developing resources which will greatly benefit the farmer. Visitors who come to hunt, fish, or spend their vacations not only bring considerable sums of money into the State, but furnish employment of various kinds. They require board and lodging which can often be had in country homes to the advantage of the boarder as well as the owner. Their presence may also provide increased home markets for poultry, eggs, butter, milk, and other farm products and may render possible the maintenance of improved railroad and telephone service in outlying districts. A striking illustration of these conditions may be found in the case of Maine. In 1904 the license fees collected from nonresidents who visited the State to hunt big game amounted to $25,365. The reports show that 1,942 guides were registered, who were employed altogether 87,785 days, and earned at a fair estimate $3.50 per day, or a total of $307,247.50. Two years ago the commission of inland fisheries and game made a careful investigation of the number of nonresidents who visited Maine outside of the seaside resorts and the amount of money which they spent in the State. These figures showed that in the summer of 1902 the number of nonresident visitors was 133,885, that their presence gave employment to 1,401 men and boys, and to 2,564 women and girls, whose wages amounted to $267,934. The amount spent for railroad fares and incidental expenses was not reported, but the expenditures for board alone amounted to $1,371,201. The permanent financial benefit thus derived by the State from nonresident travel has been summarized by Senator W. P. Frye[a] as follows:

> In all times of business depressions and distress, financial panics and consequent unemployment of labor, so seriously affecting the country, the State of Maine has suffered much less than any other State in the American Union, mostly, if not entirely, due to the large amount of money left with us by the fisherman, the summer tourist, and the fall hunter—the seeker after change, rest, and recreation.

SOME PRACTICAL ILLUSTRATIONS.

Several plans have been devised for bringing farmers into closer touch with sportsmen and increasing the practical benefits which the former may derive from impartial enforcement of the game laws. Of these plans three may be mentioned to illustrate the different methods of reaping the benefits of game protection.

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[a] Rept. Comm. Inland Fisheries and Game of Maine, for 1902, p. 21.

CONNECTICUT.

The Connecticut Association of Farmers and Sportsmen for the Protection of Game and Fish was organized on August 10, 1888, at Hartford, Conn.[a] Its general purposes were expressed in its title, but more specifically it undertook not only to protect game and fish but "to protect the farmers against those persons who mutilate stock, tear down fences or walls, and do shooting on Sunday," and "to make and prefer information against violators of such laws, and to detect, prosecute, and bring to justice all offenders against such laws, and punish them according to law, and supervise such prosecution." For fifteen years this association devoted its attention with much success to its special field of work. One of the duties undertaken was to break up the practice of snaring grouse for shipment and sale contrary to law. In this it was so successful that during the first year it secured a number of convictions and did much to restrict the killing of game in close season.

ILLINOIS.

Under the name of the Rockford Township Farmers' Association an organization was effected in 1901 in northern Illinois for the purpose of mutual protection against indiscriminate hunting on farms owned or rented by the members. The constitution and by-laws are very simple. By one of the by-laws each member is required to post notices in five or more conspicuous places on his land prohibiting hunting or trespassing, and by another to interview any person found hunting on the premises whenever it is possible, and in case such person persists in hunting after being warned, to go before the nearest justice of the peace and cause a warrant for trespass to be issued against the offender. Each member retains the right to grant to any person the privilege of hunting on his farm in his company, and undertakes to promote the strict enforcement of the game laws of the State.

The association has now been in existence for four years and numbers about 75 members. It has had under its care from 12,000 to 15,000 acres of rich farming land lying north of the town of Rockford, Ill. This land is rolling prairie planted in wheat, corn, oats, and orchards. The association has been remarkably successful in carrying out its objects. Unauthorized hunting has been stopped, not only on the farms, but also along the highways. Prairie chickens and quail are increasing in numbers and nongame birds are abundant. The members are personally interested in the increase of game birds on their premises, and guard their bevies of quail with jealous care. As an instance of this feeling it may be stated that one of the members, on being asked whether game was increasing on his place, replied that he now had a large bevy of quail, and added that he

[a] Forest and Stream, XXXI, pp. 65, 125, 1888.

valued them so highly as insect destroyers that he could better afford to have his chickens killed than his quail.

At the outset some trouble was experienced in having the lands properly posted. Difficulty was also encountered in apprehending and convicting trespassers on account of the time the complainant had to take from his work in case of an arrest, and the additional discouragement caused by frequent failure to convict or small fines. In 1899 a provision was incorporated in the Illinois game law imposing a fine of from $3 to $15 for hunting with dog or gun on the lands of another without permission. It also became the duty of the game wardens to enforce this law. Each county in the State has a game warden, and with the telephone system now extended in all directions from Rockford the members can communicate at a moment's notice with the local warden. Convictions have been secured with more certainty, and these have had a beneficial influence in deterring illegal hunting. The change in the law has required less active work on the part of the members in posting their lands and following up offenders, but it has enabled the association to carry out its objects so much more effectively that the members feel that they have a personal interest in the game law and are heartily in sympathy with a strict enforcement of its provisions.

NORTH CAROLINA.

The North Carolina laws prohibiting shooting on another person's land without permission of the owner, to which reference has already been made, were first enacted in the latter part of the eighteenth century. Not until recently, however, have the full benefits of these laws been realized. Within the past fifteen years a system of leasing has been inaugurated, which seems to meet with considerable favor, as it secures to the owner a substantial financial benefit. These leases have been most numerous in the north central part of the State, in the counties of Davidson, Forsyth, Guilford, Moore, and Randolph. It will be sufficient, by way of illustration, to describe the system as applied in Guilford County. This county comprises 680 square miles, a little more than one-half the area of Rhode Island. It contains two important towns, Greensboro and Highpoint, and its total population in 1900 was about 40,000. The farms average about 100 to 200 acres in extent. The principal crops raised are wheat, corn, cotton, fruit, and vegetables. Quail and rabbits abound nearly everywhere; in fact, quail are probably more abundant in this part of the State than in any other section of the country east of the Mississippi River. This condition is due in part to the present state of agriculture and the acreage in woodland or thicket, which furnishes excellent cover for the birds. At present about 150,000 acres, or more than one-third the area of the county, are under lease for private game preserves. These preserves do not interfere in any way with the cultivation of

the land or the rights of individuals. In most cases they have not resulted in the restriction of the ownership of the land to a few persons, nor has there been any attempt to restore the land to its original wild condition; but, on the contrary, every encouragement is given for its cultivation, while in some cases cowpeas are freely distributed by the lessees for the purpose of improving the soil and at the same time affording better food for the birds. These preserves vary in size from a few hundred to 12,000 or 15,000 acres each. They are sometimes controlled by one or two individuals, though more frequently by several persons associated together for the purpose. Comparatively little land is bought, but nearly all is held under lease. An arrangement is entered into whereby the owners of adjoining farms agree to permit no hunting on their land, except by the lessee or his friends during the open season, and the lessee either makes a cash return for the hunting privilege or agrees to pay all taxes on the property. The ordinary tax rate outside of the towns averages about 7 cents per acre, and the amount paid for rentals varies from 5 to 10 cents. Some leases are good for only one year, others for five or ten years, with the privilege of renewal.

In the case of one of the earliest of these preserves, near Highpoint, the lessee owns no land, but leases nearly 12,000 acres on a cash basis, and his annual disbursements for rental alone reach $1,200. More than one-third of the total real-estate tax of the county outside of the towns is now paid by hunting leases, and, in some cases, in which a special township school tax has been imposed, this is also paid by the lessees. In other words, the farmers, by merely keeping trespassers off their lands and joining their neighbors in leasing the hunting privileges to certain individuals or associations, are relieved entirely from their real-estate taxes or receive an equally large or even a larger amount in cash each year. Sometimes the lessees hunt very little or perhaps not at all during the season, in which cases the owners may for a year or more enjoy immunity from hunting as well as from taxation.

The satisfactory working of the North Carolina plan will doubtless cause it to be adopted in other States. As a simple and comprehensive method of meeting the conditions resulting from the ever-increasing number of hunters and the growing scarcity of game it has much in its favor. It has the advantage of permitting the sportsman to enjoy his favorite pursuit, at the same time protecting the game from excessive slaughter, and it relieves the farmer from the annoyances to which he is often subjected by unprincipled or inconsiderate hunters. Finally, it brings a substantial return to the owner for the use of the hunting privileges of his land, and thus equalizes the obligation betweer the farmer and the sportsman.

STATE PUBLICATIONS ON AGRICULTURE.

By Charles H. Greathouse,
Of the Division of Publications.

GENERAL VIEW OF PRESENT CONDITIONS.

Books on agricultural subjects are published by nearly all the States and Territories of the Union and distributed free to farmers and others interested in farming. Some States only report the transactions of the principal agricultural organizations; others gather data on crops with care and make extended investigations along the line of agricultural improvement and for defense against dangers to agricultural interests; and they publish the results of their work quite fully, some of them elaborately. It is to be observed that experiment station publications are not being considered in this discussion.

Each State conducts its publishing independently of all the other States and of the General Government, and the books are distributed without consultation or cooperation between the distributing officers. As a consequence there is no orderly division of the field in which all are working toward the same end, viz, the discovery, elucidation, and dissemination of truth helpful to farmers. Duplication of effort occurs to a considerable extent, and the more progressive farmers are often burdened with studying, or at least looking over, several books where one would be sufficient. It is such duplication of work as this among experiment stations that is avoided by cooperation with the Office of Experiment Stations of the Department of Agriculture.

Nevertheless, the State governments publish and spread among farmers and students of agriculture much valuable information that would otherwise be lost, and a generous emulation, which makes for progress, is aroused among the States.

DEVELOPMENT OF STUDY AND PUBLICATION.

The first work in agricultural investigation within the borders of this country was done in the colonies. New York, Pennsylvania, and Massachusetts perhaps took the lead in the study of farm problems, as they did in publication of methods and results of inquiries in permanent form; but much good work, including considerable publication, was done also in Maryland, Virginia, and South Carolina.

The long struggle for independence weakened the colonists in every line of industry and not least in agriculture; it was some time after the organization of the present government before investigations of

farm processes and problems resumed their course. A beginning of renewed activity was manifested in the formation in New York, Massachusetts, and Pennsylvania of societies for the promotion of agriculture. These were followed by similar societies in other States. In general in this country the formation of such State agricultural societies has preceded and led the way to the establishment of State government offices for the promotion of agricultural interests. The publication of the transactions of these societies usually has given an important series of volumes antedating the State reports on agriculture. Frequently these society transactions are embodied in and form a large part of the State reports. In some cases the work of the society has been completely replaced by that of the State government and the semipublic organization has practically ceased to exist. The direction of progress seems to be from an agricultural society to a State board of agriculture whose secretary prepares a report including the transactions of the agricultural society, and finally to a State department of agriculture with a commissioner who is responsible for the substance as well as the form of the report, in which he deals mainly with the work done under his direct supervision. Under all these conditions the printing has commonly been done at public expense.

SOME OF THE MORE IMPORTANT SERIES.

NEW YORK.

The New York reports run back at least to 1791, when "a respectable number of citizens," with Hon. Ezra L'Hommedieu in the chair, met to form a society for the promotion of agriculture and manufacture. On February 26 in that year, with Hon. John Sloss Hobart presiding, the society adopted rules and regulations and elected Hon. Robert R. Livingston president. A bulky volume of 462 pages preserves the transactions and important papers of this organization from 1791 to 1798, inclusive. One of the secretaries was Dr. Samuel L. Mitchell, whose historical work was at times the object of Irving's satire. Under a new incorporation the name of the organization became "The Society for the Promotion of Useful Arts," and other reports were printed.

The New York board of agriculture reports, well edited and printed, in three volumes, cover the period from 1821 to 1826. The last volume has 558 pages, with an index, and contains several plates. In 1832 an effort was made to establish the New York State Agricultural Society, but it was not until 1841 that work was actually begun. From that date runs an unbroken series of substantial, useful volumes, one for each year, until 1895, when the New York department of agriculture was established. Its reports have since been issued in several volumes each year, and form an important source of agricultural information.

MASSACHUSETTS.

The Massachusetts Society for Promoting Agriculture was established in 1792 and published numerous papers, but the State series may be said to begin with four volumes prepared by Rev. Henry Colman for the years 1837–1840 and printed by the State. Abstracts of county society returns were authorized in 1845 and were published till 1852. The first contained 198 pages, without illustration. In 1847 the title "Agriculture of Massachusetts" began to be used, but not until 1853 do the State board reports appear. In 1865 Charles L. Flint, whose labors as secretary are memorable, changed the form of the report so that each annual covers part of two calendar years, and these volumes, called "second series," run from 1865–66 to 1879–80. In 1880 another report was printed, and from that time each report covers one calendar year. In 1893 an index of the reports from 1837 to 1892, by Frederick H. Fowler, was published.

PENNSYLVANIA.

The Pennsylvania reports as they appear in the libraries begin with eleven volumes of the Pennsylvania Agricultural Society issued from 1854 to 1876; but it is known that many publications giving the transactions of the earlier societies were printed before that time. Among these are memoirs of the Penn[a] Agricultural Society, 1824, and of the Philadelphia Agricultural Society, 1808–1826. The volumes of State board reports date from 1877, one for each year, and close with 1894. In 1895 the Pennsylvania department of agriculture was established, and the reports from that year till 1903 were issued in two parts for each year. They furnish a large amount of information. In 1902 part 1 contained 1,029 pages, with numerous plates, and part 2, 323 pages. The one volume report of 1903 contains 957 pages.

WESTERN AND SOUTHERN.

The Ohio board of agriculture was established in 1846, and reports were published annually till 1857, when a second series was begun which continued till 1877. In 1878 the name "second series" was dropped, and the reports continue till the present. The volume for 1902, distributed in 1904, contains 966 pages. Farmers' institutes occupy 226 pages; crop and other statistics, 169 pages; horticulture, including orchard inspection, 194 pages; the live-stock commission, 29 pages. The transactions of the board for both 1902 and 1903 are published in this volume.

The Indiana reports begin with 1851–52 and run to the outbreak of the war. Then the great excitement due to raising and equipping troops caused a discontinuance till 1867, when a report was issued covering the transactions of the State Agricultural Society for the years 1862–1867. The editor of that volume says the society's room in the statehouse was taken in 1861 for military purposes, the geological specimens were "jumbled into boxes in the cellar," and the books,

papers, etc., scattered. The series then continues in unbroken line to 1903. The volume of 1899 contains 1,091 pages, illustrated.

Similar reports covering very nearly the same period were issued by Illinois. Since 1871 these have come from a State department of agriculture; and while the later reports have contained little more than details of awards, etc., at the State fair, the reports of farmers' institutes started in 1896 are full of information and suggestion; also, the Illinois Horticultural Society prints valuable reports.

Iowa reports begin with 1854. The second issue, in 1855, is a pamphlet of 44 pages. From 1856-57, when a volume of 458 pages was published, there is a good series, including the 1903 report, issued in 1904, which contains 736 pages, with illustrations and index. The horticultural society reports form an interesting series beginning with 1867.

North Carolina, Georgia, Kentucky, and Tennessee have publications antedating the civil war, which give valuable information on farm resources and farming in the South Atlantic section and the southern Ohio Valley. The Missouri reports became of special value after 1865, when the State board of agriculture was established. The Michigan and Wisconsin series have been steadily maintained in a high degree of usefulness since 1849 and 1851, respectively. An index for the Michigan reports, 1849-1888, was published in 1889. Kansas has twenty volumes, biennial since 1876, and many smaller publications, including quarterlies. The Nebraska reports have been usefully kept up since 1868, mainly by the efforts of ex-Governor Robert W. Furnas, who was president of the board then and is secretary now.

NOTES FROM THE REPORTS.

Even a running examination of these books brings to light information at times mainly curious, but also very often valuable.

The Indiana report for 1859-60 contains a letter from Alexander von Humboldt, written in 1858, the year before his death. He says, after mentioning the aid of the American minister:

> I have received the important reports of the Indiana board of agriculture; and if I have deferred so long to offer the homage of my respectful acknowledgments to the president of that noble institution, the delay was caused only by indisposition.
>
> The volumes of the transactions which I have been able to peruse prove that at Indianapolis they know how to manage the interests of agriculture with intelligent sagacity and understand the improvement of natural resources.

The report by William S. Wait, of Greenville, Ill., secretary of the Bond County Society, dated January 2, 1855, shows that a practice which has of late years received much attention and found a place at the St. Louis World's Fair was begun in that region long ago. Mr. Wait says: "In order to encourage the boys to work, premiums are offered for the best acre of corn grown and cultivated by any person under 21 years."

Between the covers of a single New Hampshire report, 1850-1852, are four short addresses by Franklin Pierce and Daniel Webster, both

natives of the State. In 1851 Mr. Webster, in one of his last public speeches, raised his voice against "a spirit of disunion" which would surely "lead to destruction."

The fiftieth anniversary (1902) meeting of the Massachusetts board was addressed by the late ex-Governor George S. Boutwell, among others. He told how in the fifties he brought a mowing machine to his farm. His foreman said he could not run it, and anyway two good men could do as much as the machine. But Mr. Boutwell told the foreman's 15-year-old boy he would add 50 cents a day to his wages if he would run the machine, and after two days the father changed his opinion.

A new way of keeping dirt roads in good order is presented in the Missouri report for 1902 by its originator, Mr. Ward King, of Maitland, Mo. It is very simple. Mr. King states that by dragging with "an old post and a frost-bitten pump stock" pinned together, he kept the clay road near his place in good condition, except just after a rain or a big thaw. He improved his method by splitting logs in half to make the drag, and by the use of nine such drags he and his neighbors in less than a year made the 4 miles to Maitland the best dirt road he ever saw. The special points of his method are to hitch to the drag so as to draw the earth toward the center of the road, and promptly at the beginning of every thaw and after every rain to drag the surface of the road smooth, so as to leave no holes, ruts, nor hoof prints to hold water.

The late Col. J. H. Brigham, Assistant Secretary of Agriculture, read a paper on irrigation of arid lands, at the State Farmers' Institute at Columbus, Ohio, in January, 1903, which appears, with an interesting discussion of it, in the Ohio report for 1902. Colonel Brigham, in closing his remarks, said millions of acres would be sold under the stimulus of the new movement "that never can be irrigated or farmed successfully."

PRESENT CONDITIONS.

The officials in charge of agricultural interests in the several States and Territories of the Union so far as they could be reached, have stated, for use here, the conditions and methods of their work at the close of the calendar year 1904.

PUBLICATION.

Annual reports are issued by California, Connecticut, Colorado, Delaware, Hawaii, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maine, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, New Jersey, New York, Ohio, Oklahoma, Pennsylvania, the Philippine Islands, Porto Rico, Rhode Island, Texas, Vermont, Virginia, and Wisconsin. The Colorado report is bound in the same cover with the Experiment Station Report.

Biennial reports are published by Arkansas, Florida, Idaho, Kansas, Montana, New Hampshire, North Carolina, North Dakota, West Virginia, and Wyoming. From Arizona, Maryland, New Mexico,

Tennessee, and Washington are issued handbooks showing resources and products, which furnish information for intending settlers. Georgia has an annual report on chemical fertilizers and publishes a handbook of resources. Oregon and South Dakota do not now publish reports, and from Alabama, Mississippi, Nevada, South Carolina, and Utah no satisfactory data were obtained. California, Maryland, Nevada, South Carolina, Tennessee, Texas, and Utah publish farmers' institute proceedings; so, also, do 22 other States in addition to their regular series of annual or biennial volumes. Many States also publish reports of horticultural societies and other agricultural organizations. Massachusetts, Missouri, North Carolina, Pennsylvania, and Wisconsin publish monthly bulletins, while West Virginia publishes a monthly agricultural paper. Other States publish bulletins at irregular intervals, some in series, some not. Pennsylvania has such a series which numbers over 130 very useful pamphlets. Maine and Kansas publish quarterly bulletins.

DISTRIBUTION.

The distribution of these publications is effected mainly through the mails. When issued regularly as often as quarterly they go through the mails at the second-class rate, 1 cent a pound. This privilege is given by an act of Congress of June 6, 1900, passed largely through the efforts of the North Carolina department of agriculture. In some States an appropriation for postage is provided, but occasionally the postage on an important book is charged upon the applicant.

The State reports are sent to the members of the legislature, public libraries, farmers, and citizens interested in farming. The quarterlies, monthlies, and irregular bulletins are sent to nearly the same classes as the reports, but more attention is paid to getting them into the hands of persons actually engaged in farming. Any farmer who can give satisfactory evidence that he intends to use the book in connection with his work can usually obtain any State agricultural publication without cost. In West Virginia the monthly farm paper is sent at the nominal subscription price of 5 cents a year.

Distributing officers have regular mailing lists, some of them numbering several thousand, and the remainder of the books after lists are supplied are sent on application. The editions of annual reports range from 2,500 copies in Delaware to 31,500 in Pennsylvania. Of the farmers' institute reports, the numbers range from 1,000 in Indiana to 6,000 in Wisconsin.

The printing is usually done by the State printer, sometimes under a general law accompanied by an appropriation for the purpose. In Minnesota and Wisconsin farmers' institute handbooks are made to bring in revenue from advertisers.

The estimate of the value of these publications is steadily rising. Practical men find them useful in their work. Students also are coming to recognize them as sources of information of high authority, and they find a place in very many libraries.

ANIMAL BREEDING AND FEEDING INVESTIGATIONS BY THE BUREAU OF ANIMAL INDUSTRY.

By D. E. Salmon, D. V. M.,
Chief of the Bureau of Animal Industry.

PLAN OF OPERATION.

One of the most noteworthy undertakings of the Bureau of Animal Industry during recent years is the inauguration of investigations in animal breeding and feeding in cooperation with the State agricultural experiment stations. At the second session of the Fifty-eighth Congress a fund of $25,000 was appropriated for this purpose, and plans were at once begun to carry out the purposes of the act. Four general sections were considered in locating the work—the West, the Central States, the East, and the South—and problems are now being worked out in all but the Central West, where investigations will probably be commenced during the coming year.

In planning the work it has been decided to give special attention to problems in animal breeding, for several reasons. Animal breeding as a field for systematic research is not greatly affected by local conditions, and very few investigations have been undertaken by the experiment stations or the Department. The feeding of animals, on the other hand, is influenced by a very great variety of such conditions, and experiment stations, which have covered this field quite thoroughly, are constantly adding to our knowledge of the subject. Furthermore, investigations in animal breeding require resources that are at the command of few stations. In carrying out the provisions of the act in question regarding experiments in animal feeding, some work will be done in practical feeding under local conditions, but the principal lines of research of this nature may be confined, it is hoped, to scientific investigation of the principles of nutrition.

The stations with which the Department is cooperating are the Pennsylvania experiment station in animal nutrition, the Iowa experiment station in sheep breeding, the Maine experiment station in poultry breeding, the Colorado experiment station in horse breeding, the Alabama experiment station in beef and pork production, and the Texas experiment station in feeding beef cattle. These problems were selected as being urgent ones, and the locations give the work a representative character.

In carrying out the provisions of this act and making agreements with the different experiment stations, the Department has arranged in a general way for a division of expense, which will make the station

financially interested in the success of the work, and will give a reasonable return for the assistance it receives. It has sometimes been necessary, however, for the Department to contribute a larger sum of money than the station was able to provide, for the reason that most of these institutions had made arrangements for the expenditure of all available funds for several years ahead, and to ask them to contribute a sum of money equal to that which the Government could provide would cripple them financially or entirely preclude their entering into cooperation for this purpose. However, it must be recognized as a great advantage that stations have connected with them trained men familiar with the conditions of their States, whose ability to conduct the work on the ground is an invaluable asset which could be obtained only by liberal arrangements on the part of the Department.

ANIMAL NUTRITION.

Cooperation was established several years ago with the Pennsylvania experiment station to start systematic investigations in animal nutrition. A respiration calorimeter, modeled on that erected by Professors Atwater and Rosa for the study of human nutrition and adapted for use with animals, has been installed. A large amount of material has been gathered, and the results of the first series of investigations on the available energy of timothy hay have been published as Bulletin No. 51 of the Bureau of Animal Industry. These investigations have been supplemented by an allowance from the cooperative breeding and feeding fund for investigations on the influence of age and individuality on the nutrition of animals. Two young steers have been purchased—one a purebred Aberdeen Angus, the other a purebred Jersey. It is intended to study their metabolism until maturity.

SHEEP BREEDING.

The Iowa experiment station has been selected as a point to begin the development of sheep more suitable to range conditions than those used at present. Under the conditions of the market the ideal range sheep should have three prominent characteristics; it should yield a profitable carcass, a good clip of wool, and should stand flocking in large numbers. Many of our breeds of sheep are valuable in two of these particulars, but none possesses all. If a breed can be developed which will fill all the requirements mentioned, it is believed that it will be of much value to sheepmen on the range. The Iowa station now has a small flock which it has built up by crossing and selection, and hopes in a few years to have fixed the type so that the sheep may be tested under range conditions.

POULTRY BREEDING.

The Maine experiment station has been making a special study of poultry breeding for several years, and the Department is now assisting in this work. The object of the investigation is twofold—the

development of strains which will lay 200 eggs annually per hen and the study of the amount of floor space required per fowl. The production of a hen which will lay 200 eggs in one year is an accomplished fact, but when this is done it usually happens that in the succeeding year the egg yield is very greatly diminished, and in some cases the hens have died, apparently from exhaustion. The point has not yet been reached where a family can be depended upon to produce hens which will lay 200 eggs year after year, though this may be accomplished in time; nevertheless, the development of a family which may be depended upon to produce 200 eggs per bird during the first laying year is a distinct advance and of much value. The study of floor-space requirements in connection with this work is an allied field of investigation made possible by the erection of a new poultry house, the fowls being kept in pens of different sizes.

HORSE BREEDING.

Horse breeding is the most important line of work in animal breeding which the Bureau has undertaken, and it will be discussed in considerable detail.

INCREASE OF PRICES AND SCARCITY OF HORSES.

The situation in the horse market during recent years has had a great deal to do with determining the lines of work to be undertaken in this respect. From the years 1899 to 1904, inclusive, there has been an increase, ranging from $10 to $35, in the average prices for all classes of horses on the Chicago market, as shown by the following table:

Increase in prices of horses on the Chicago market, 1899–1904.

Class.	Range of prices.		Increase.
	1899.	1904.	
Drafters	$155	$177	$22
Carriage pairs	410	475	[a]65
Drivers	140	150	10
Horses for general use	105	140	35
Bussers and trammers	115	140	25
Saddlers	150	160	10
Southern chunks	50	64	14

[a] Increase per pair.

This table shows what always happens during a period of scarcity, namely, a large increase in the prices of the best grades, the average price of carriage horses increasing $32.50 per head; but there is one very remarkable feature in the large increase in the prices of the cheaper grades. Horses for general use show the largest increase of any, $35 per head; bussers and trammers have increased $25 per head; and Southern chunks $14 per head. The relative increase in these cheap classes has been greater than that of the better ones, and the fact shows clearly that the demand for horses has rapidly increased.

This situation causes a tone approaching that of alarm to pervade the horse market, and, while they are always inclined to bear the market, dealers seem to have good reason for concern in this instance. The conditions on the Chicago market are a good indication of those for the entire country.

RELATION OF THE EXPORT TRADE TO THE HORSE MARKET.

The relation of the export trade to the horse market is peculiar. The Columbian Exposition at Chicago marked the beginning of a very strong demand from Europe for American horses, and export buyers were soon prominent on the market, with the result that prices advanced rapidly. The condition of this trade during the past decade is shown by the following table:

Domestic exports of horses of the United States, 1895–1904.

Year ended June 30—	Number.	Value.
1895	13,984	$2,209,298
1896	25,126	3,530,703
1897	39,532	4,769,265
1898	51,150	6,176,569
1899	45,778	5,444,342
1900	64,722	7,612,616
1901	82,250	8,873,845
1902	103,020	10,048,046
1903	34,007	3,152,159
1904	42,001	3,189,100

The great increase from 1900 to 1902 is due to the exportations to South Africa, which have now almost entirely stopped.

It will be observed that the number of horses exported is still normal. This, however, is due to the increase in the exports to British North America and the West Indies. There is also a strong demand from Mexico. The trade with the United Kingdom (our heaviest European purchaser) fell during 1904 to a lower point than in any year in the last decade, and the exports to British North America may be accounted for by the large agricultural emigration to Canada during recent years.

The following table shows the exports to the United Kingdom and British North America. The European demand for our horses was soon followed by rapid improvement in business conditions in this country, and this resulted in a very greatly increased domestic demand for horses, with the rise in prices already mentioned. This advance has caused the falling off in exports to Europe; where we were sending several thousand each month we are now sending hundreds, and export buyers have either returned home or engaged in the domestic trade in the United States.

Domestic exports of horses of the United States to the United Kingdom and British North America, 1895–1904.

Year ended June 30—	United Kingdom.		British North America.	
	Number.	Value.	Number.	Value.
1895	5,834	$952,532	4,493	$710,727
1896	12,022	1,776,600	5,683	693,639
1897	19,350	2,579,736	3,902	473,574
1898	22,129	3,072,498	9,415	874,674
1899	20,934	3,024,952	10,088	667,165
1900	30,232	4,205,376	8,830	857,206
1901	22,698	3,481,467	9,305	863,631
1902	10,015	1,593,340	23,183	1,808,298
1903	3,755	688,940	24,965	2,121,864
1904	2,325	412,760	24,686	2,099,985

For the horse breeder the continuation of this trade is a favorable state of affairs, for the reason that if the home market is threatened with overproduction an outlet by means of exportation can readily be obtained. The reputation of American horses abroad is thoroughly established, and if prices fall again foreign buyers will no doubt soon appear and the surplus will be absorbed.

MEANS OF RELIEF.

The present shortage may be relieved by two means: First, by the direct importation of breeding animals from foreign countries in larger numbers than before; second, by developing new breeds from our own stock or by improving those which already exist. To a great many unprejudiced observers it has seemed that the most advisable method would be the former, and they would urge breeders to take the established types on the other side of the Atlantic and transplant them in large numbers to this country, using the argument that we have a present crisis to meet and that we should not consider seriously a long-time proposition which would benefit only the grandchildren of the present generation.

While the Department recognizes the strength of these arguments, it believes that the second plan is the more practical one and will result in greater permanence and more lasting benefit to the horse industry than the former; and that the expense and the length of time required will not be so great as some have anticipated if the enterprise is properly managed. Further, it may be seriously questioned whether the supply of good breeding animals in foreign countries will permit the drafts upon it necessary to bring our horses to the required standard and meet the present emergency.

THE TROTTER AS A FOUNDATION FOR AN AMERICAN BREED OF HORSES.

In the countries of the world where horse breeding has been encouraged by government assistance, the foundation has been native stock, and the key to successful work has been selection according to a certain type. Furthermore, with all due respect to Godolphin Arabian,

the Darley Arabian, and their contemporaries, the great factor in developing the Thoroughbred horse was the method of the English breeder, and more credit is due to native English stock and to environment than has generally been acknowledged.

What the Thoroughbred horse is to the Englishman, the trotting horse is to the American; the breeds are the national horses of their respective countries, and, as the Thoroughbred has been the great leavening power in developing English breeds of light horses, the trotter may bear the same relation to the horse stock of America.

The trotter is found throughout the country wherever horses are raised, and any improvement in this breed affects in time the entire horse industry. The light market classes can be supplied from this source, and there is no more effective way to provide a supply of suitable cavalry horses for the United States Army than by showing how the native horse may be improved.

That the trotter has faults no one will deny, and that the speed idea has been responsible for many of these faults, and has caused many a man to become bankrupt, is equally certain. If a horse can trot in 2:10 or better, it is reasonably certain that he will make his owner money, and it matters not how homely or unsound he may be; but if the horse has bad looks and unsoundness, and also lacks speed, he will be unprofitable on the track and can not be sold at a profitable price on the market; while, if used in the stud, his undesirable qualities are perpetuated. On the other hand, if the horse has moderate speed, but is sound, handsome, and stylish, with a shapely head and neck, a straight, strong back, straight croup, muscular quarters and stifles, well-set legs, possesses good all-round true action, and has abundant endurance, he is almost certainly a profitable investment. This is the kind of light horse which the market wants and will pay for. If of the roadster type, he sells well as a driver; if more on the heavy harness order, as a carriage horse.

The occurrence of trotting-bred horses of the finest conformation is by no means uncommon; it is so frequent indeed that these animals supply not only the demand for roadsters, but the principal part of the fine city trade in carriage horses, and are conspicuous winners at the horse shows. The demand for such horses has been so keen that dealers have resorted to the pernicious practice of buying mature stallions, many of them valuable breeders, and castrating them to be sold later as carriage horses. The famous Lord Brilliant, three-times winner of the Waldorf-Astoria gig cup at Madison Square Garden, is a notable instance of this practice; Lonzie, a noted Chicago show horse, is another; and the horse purchased for the Department experiments narrowly escaped the same fate. This practice can not be too strongly condemned. There is reason to believe that if these stallions were used as the nucleus of a breed, the type would in time become fixed and their blood be saved to the country. On the other

hand, if steps are not taken to mold the blood of these horses into one breed and preserve the blood lines which produce them, an irreparable loss to the industry will result. The first step should be to select foundation stock strictly according to type; the next to study the lines of breeding which produce these horses. To a certain extent they are accidents of breeding, but there is little doubt that certain families show a greater tendency in this direction than others. For example, the descendants of Alexander's Abdallah, Harrison Chief, the Morgans, and the Clay family have been more or less notable in this respect. Further, certain sires are known to produce handsome and marketable horses with regularity.

EFFORTS OF DEPARTMENT FOR DEVELOPMENT OF A BREED OF CARRIAGE HORSES.

In view of these facts, the Department decided to undertake the development of a breed of carriage horses on an American foundation as an interesting and important problem for solution. If successful, it will show that we can develop our own breeding stock of horses in this country; it will make light horse breeding less of a lottery than it is at present, and will at the same time provide breeding animals which can be used profitably on the lighter horses of the country.

After a thorough search the Department has purchased as foundation stock eighteen mares and one stallion. In addition it can command the services of additional stallions if desired. The instructions of the purchasing board allowed considerable latitude, but it was required to select strictly according to type. Hereditary unsoundness was regarded as a disqualification. Pedigree was not considered so far as registration was concerned, but the board required evidence to be submitted showing that the animals purchased were from parents and ancestors of like type, thus insuring blood lines that would breed reasonably true. Speed, while not ignored, was not made an essential. Life, spirit, and energy, with moderate speed, were considered, and, while conformation was not sacrificed to speed, speed with conformation and good action was regarded as an advantage.

The type for mares was one standing about 15.3 hands, weighing 1,100 to 1,150 pounds, bay, brown, or chestnut in color, with stylish head and neck, full-made body, deep ribs, straight back, strong loin, straight, full croup, muscular forearms, quarters, and lower thighs; good all-round action was insisted upon. Any tendency to pace or mix gaits was regarded as ground for disqualification. In some cases, mares of more than 15.3 hands were purchased, and in others they were less than this. All, however, conformed closely to the type. Some of the mares are in foal; the rest will be bred during the spring of 1905.

The ancestors of six mares purchased in Wyoming have been bred for five or six generations in that State, the band having been started by means of an importation of horses from the Central West which

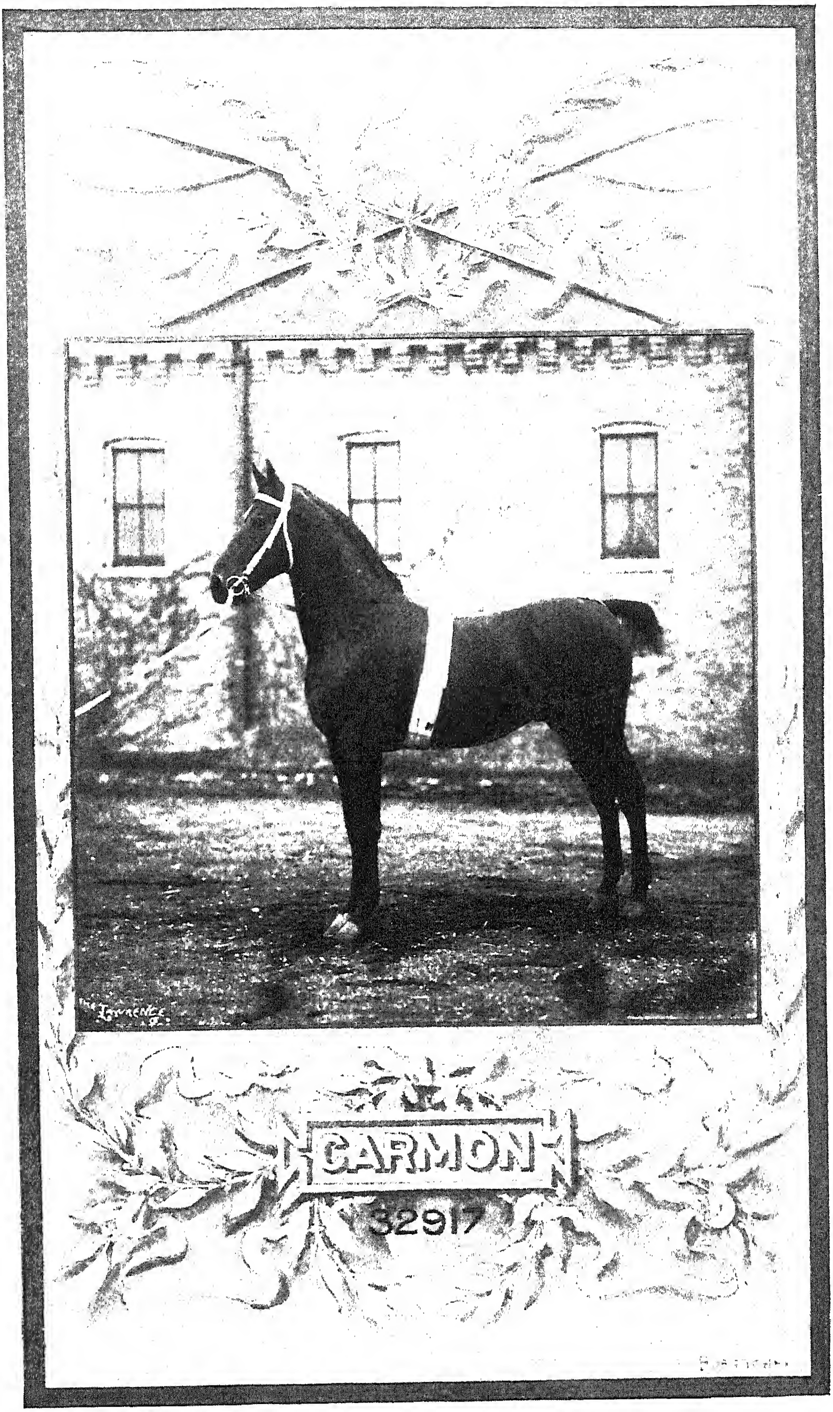
was largely of Morgan stock. On this stock Thoroughbred and standard sires have been used and the herd has been developed more to produce a horse suitable for carriage purposes than one which had speed characteristics. Some of the six have been exhibited at the New York horse show, and the owner of the ranch maintains a stable near New York City where he sends his surplus from year to year to be finished for the fine city trade.

The search for a stallion to head the stud was the most difficult of all. An almost unlimited number of trotting horses suitable to get good carriage horses were recommended to the Department, but on investigation it would be found that they were deficient in some respect and could not be considered. A horse was finally selected which was among the first suggested: Carmon 32917 American Trotting Register, 16 hands, weighing 1,200 pounds in fair condition, bay, with black points and no white markings, bred by Hon. Norman J. Colman, of St. Louis, Mo. This horse was exhibited by Mr. Thomas W. Lawson, of Boston, Mass., as one of his famous four-in-hand, under the name of "Glorious Thundercloud."

The points of Carmon's conformation which deserve special mention are his head and neck and hind quarters. His forehead is broad and full, with a straight nose and face; full, expressive eyes, and well carried ears. The neck is clean, muscular, and well arched. The illustration (Pl. LXXI) does not do him justice in these respects. In the hind quarters, special attention should be directed to the straight, broad croup and the muscular quarters and lower thighs. The horse has an abundance of bone and substance, but ample quality at the same time. His action is excellent.

A study of Carmon's pedigree (fig. 60) will show that it is not a particularly fashionable one from the standpoint of the man who is breeding solely for speed. This is a pedigree from which one might expect a horse of excellent conformation. Robert M'Gregor, for example, was a horse with especially well developed hind quarters, and this characteristic is seen in his sons and grandsons, as shown by Cresceus and Carmon. Abdallah 15 was a horse with a particularly attractive head and neck. The frequency with which the Abdallah cross appears in Carmon's pedigree, and the presence of Morgan, Mambrino Chief, and Clay blood readily explains where this horse gets his handsome head and neck and his full quarters and stifles. These families have produced some of our handsomest horses. Their blood makes up nineteen sixty-fourths of Carmon's pedigree.

The small percentage of pacing blood is worthy of particular notice. Further, the prominent trotting sires in it have produced more trotters than pacers, and Robert M'Gregor, Abdallah 15, and Ethan Allen are noteworthy for the very small number of pacers sired by them or produced by their sons and daughters. This is so small that they may be regarded strictly as sires of trotters. Abdallah 15 and Ethan Allen



THE FIRST SIRE SELECTED FOR USE IN THE EXPERIMENTS OF THE DEPARTMENT OF AGRICULTURE TO DEVELOP AN AMERICAN BREED OF CARRIAGE HORSES.

sired no pacers, and of the immediate get of Robert M'Gregor less than 10 per cent are pacers.

The horses purchased are on the farm of the Colorado Agricultural

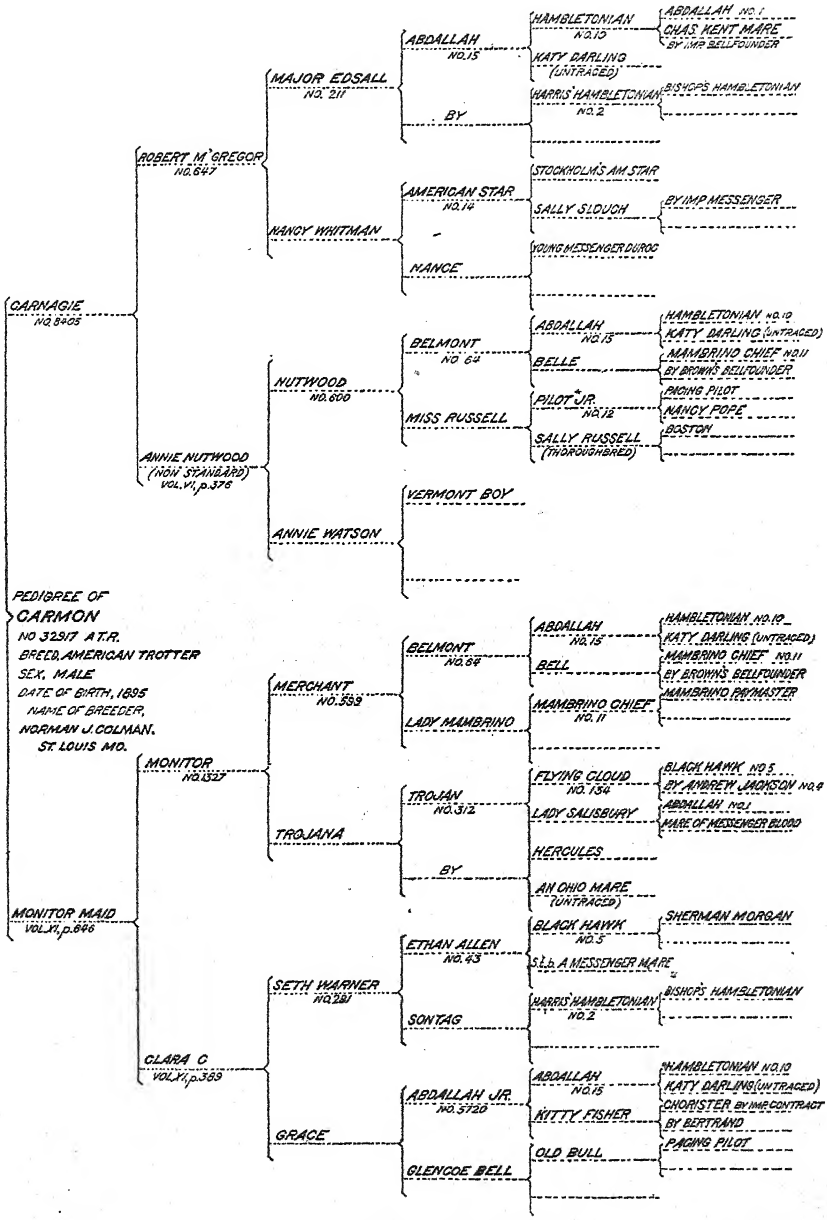


FIG. 60.—Pedigree of Carmon 32917.

College. In the management of the stud the most rigid selection will be practiced, and no animals will be retained for breeding purposes that do not conform to a high standard.

BEEF AND PORK PRODUCTION UNDER SOUTHERN CONDITIONS.

In cooperation with the Alabama experiment station, experiments are being inaugurated to study the economy of beef and pork production under southern conditions. The work will be directed along three general lines: (1) A feeding experiment with southern steers on southern feed; (2) the establishment of a herd of beef cattle; (3) pork production.

Fifty steers have been on feed during the past winter. They were selected from a herd of Alabama steers, in which there was considerable improved blood, and were fed to study the value of southern feeds in beef production. This experiment is intended to be a preparation for more extended work, which is contemplated in the future.

In the establishment of a herd of beef cattle about twenty cows will be purchased, and one purebred beef bull. The cows will have been bred in the South and will be immune from Texas fever; they will be grades of one of the beef breeds, if such animals are obtainable, in which case the bull will, of course, be of the same breed. These cattle will be placed on a farm leased for the purpose under the care of a competent man. The object of this work will be a demonstration of the advantages of grading up a herd for commercial purposes, and a study of the economy of such methods in the South. As in the horse-breeding work, the most rigid culling will be done, and the offspring will be fattened and sold from time to time.

The work in pork production has not yet been definitely decided upon, but will probably include among other things the study of the value of cassava in hog feeding. A crop of cassava and seed canes of cassava will be procured for this purpose.

It is worthy of note that the Alabama experiment station has turned its entire available fund for animal industry into this cooperation.

Plans have been perfected to cooperate with the Texas experiment station in feeding low-grade rice to cattle. In the rice-growing districts of the South there is a considerable loss each year from the fact that a certain percentage of the crop is unmarketable, owing to damage in harvesting or while in storage, which renders it undesirable for human food. The by-products of rice mills, such as rice polish and rice meal, have been found to have considerable value for feeding purposes, and it is thought that the rice grain itself may be even more valuable than the by-products. Further, if rice can be profitably fed to live stock it will provide for the consumption of any surplus which may exist, and thus the danger of overproduction may be avoided. This investigation will have an added interest to southern feeders, for the reason that one of the feeding problems in that section is to obtain an economical carbohydrate concentrate which can be used to supplement cotton-seed meal and nitrogenous roughage.

PROPOSED INVESTIGATIONS.

In addition to the foregoing work, negotiations are pending with other stations to conduct experiments during the present year, and to formulate plans for work to be started as soon as funds are available.

Plans are being discussed with the Iowa experiment station for experiments in the production of dual-purpose cattle. One of the problems of farmers in the Central West is to obtain cows which will produce milk and butter profitably for home consumption, and drop calves which, if desired, will make marketable beef. Under the diversified agriculture of that section, the farmer owns but a few cows. Special purpose dairy cows are regarded as unprofitable, because when their life in the dairy is completed their value for beef is not great; moreover, the veal industry is not extensive, and cattle feeders will not buy calves of the dairy breeds. Such calves must, therefore, be disposed of at a loss or killed at birth. It has been quite clearly demonstrated that a dairy-bred steer is not profitable for beef production, but it is by no means proved that a cow of beef type will not yield the farmer a satisfactory profit at the pail. Indeed, the evidence seems to indicate the reverse. During their history, various families of Shorthorns have been famous as milk and beef producers, and many cows possess these characteristics to-day. The tendency of breeders in the United States, however, is to abandon entirely the deep-milking characteristic, and to develop these animals solely as beef producers. Systematic efforts can prevent this loss of one of the valuable characteristics of the breed. The dual-purpose character is common to the Red Polled, the Polled Durham, and other breeds; the problem thus promises considerable success and has many interesting features. These investigations will not in the least endanger the status of the strictly dairy breeds. For the dairymen there is little doubt that the single-purpose breeds are most desirable, but for the general farmer, with a lack of adequate labor, who can not engage extensively in dairying, an entirely different animal appears to be needed.

OBJECT OF THE WORK.

Speaking broadly, the object of these experiments is the development of American breeding stock and the encouragement of a tendency to ultimate independence of foreign breeders. The Department believes that our tariff laws should always be liberal regarding the importation of the very highest types of breeding animals, whose use on our stock would result in unquestioned benefit, but it is of the opinion that the importing system is carried to an extreme at times and that in many cases animals are imported solely for speculation. As the system now stands it is an anomaly, especially in the case of horses. Attention is concentrated on the importation of stallions; mares are rarely bought. Now, these stallions have been bred up in Europe from the native

stock and the registration of animals bred in this way is still possible abroad; but when such horses are brought to this country their offspring are not eligible to registry unless out of registered dams, and registered dams are scarce, because so few mares are imported. In the case of the Percheron breed, for example, the studbooks are now closed to horses bred by crossing registered stallions on native mares. A system which leads to the importation of such horses is unfair to the American breeder and creates a monopoly in the hands of a few men who also have a certain amount of control over the studbooks.

A much more reasonable system has developed among cattle breeders. Large numbers of females have been imported and breeds were rapidly established. It is now claimed that as good Jerseys and Holsteins are bred in the United States as can be imported, and Hereford breeders have so adapted their breed to the peculiar conditions under which cattle are handled and have catered so successfully to the demands of the market that breeders no longer think of importing unless to get a particular line of breeding.

If the Department experiments in carriage-horse breeding are successful, it will be proof positive that we can develop breeds of light horses. If this can be done, we can also fix the types of draft horses now in the country.

As a broader problem, the study of animal breeding should be taken up to increase the efficiency of the breeds that are now established. Extensive investigations have been carried out in the feeding of animals, and the knowledge of the country is quite accurate and extensive on this subject. As regards practical breeding, however, our knowledge has advanced very little during the past thirty years. If America would be a breeding ground, and not a country of feeding and trading operations, dependent on others, these problems must be taken up. Increasing the fertility of hogs, breeding disease-resistant strains, breeding for increased yields of milk, butter, wool, meat, and work, are among the subjects which may be studied to the increase of the wealth of the nation.

The Department has no desire to injure any honest breeder or importer; it does not seek to promote the interest of any particular breed above others, nor have its plans been drawn up with the idea of displacing any breed already established. Those problems are being attacked which seem most urgent and whose solution will have the most far-reaching effect on breeding interests.

APPENDIX.

ORGANIZATION OF THE DEPARTMENT OF AGRICULTURE.[a]

SECRETARY OF AGRICULTURE, James Wilson.

The Secretary of Agriculture is charged with the supervision of all public business relating to the agricultural industry. He makes such regulations for interstate traffic in live stock as may be necessary to prevent transmission of contagious diseases, and has charge of all interstate quarantine. He directs the admission or exclusion of live animals from foreign countries, and has charge of quarantine stations for importing cattle. He conducts the inspection and regulates the conditions of shipment of live stock and of meat products exported from American ports. He exercises advisory supervision over the agricultural experiment stations deriving support from the National Treasury.

ASSISTANT SECRETARY OF AGRICULTURE, Willet M. Hays.

The Assistant Secretary performs such duties as may be required by law or prescribed by the Secretary. He also becomes Acting Secretary of Agriculture in the absence of the Secretary.

CHIEF CLERK, S. R. Burch.

The Chief Clerk has the general supervision of the clerks and employees; he is charged with the enforcement of the internal regulations of the Department; and is, by law, superintendent of the buildings occupied by the Department of Agriculture. He represents the Department on the Government board of the Lewis and Clark Centennial Exposition, Portland, Oreg.

APPOINTMENT CLERK, Joseph B. Bennett.

The Appointment Clerk prepares all papers involved in the making of appointments, transfers, promotions, reductions, details, furloughs, and removals for the entire Department, and decides all questions relating to the civil-service regulations affecting the same. He has charge of all correspondence of the Department with the Civil Service Commission, and of all certifications and communications issued by the Commission to the Department. He keeps the personal records of all employees of the Department, and is custodian of their oaths of office and efficiency reports. He is also custodian of the Department seal.

CHIEF OF SUPPLY DIVISION, Cyrus B. Lower.

The Supply Division has charge of purchases of supplies and materials paid for from the general funds of the Department.

BUREAUS, DIVISIONS, AND OFFICES.

WEATHER BUREAU (corner Twenty-fourth and M streets NW.).—*Chief,* Willis L. Moore; *Assistant Chief,* Henry E. Williams; *Chief Clerk,* Daniel J. Carroll; *Private Secretary to Chief,* Edgar B. Calvert; *Editor Weather Review,* Cleveland Abbe; *In charge Special Researches,* F. H. Bigelow; *In charge Instrument Division,* Charles F. Marvin; *In charge Forecast Division,* Edward B. Garriott; *Assigned as Official Forecasters,* Alfred J. Henry and Harry C. Frankenfield; *Chief of Climate and Crop Division,* James Berry; *Chief of Division of Meteorological Records,* William B. Stockman; *Chief of Publications Division,* John P. Church; *Chief of Telegraph Division,* Jesse H. Robinson; *Chief of Division of Supplies,* Frank M. Cleaver; *Librarian and Climatologist,* Herbert H. Kimball.

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[a] The organization of the Department here given is in accordance with the act approved March 3, 1905, making appropriations for the fiscal year beginning July 1, 1905, and shows changes in personnel to April 1, 1905.

The Weather Bureau has charge of the forecasting of weather; the issue of storm warnings; the display of weather and flood signals for the benefit of agriculture, commerce, and navigation; the gaging and reporting of river stages; the maintenance and operation of seacoast telegraph lines, and the collection and transmission of marine intelligence for the benefit of commerce and navigation; the reporting of temperature and rainfall conditions for the cotton, rice, sugar, and other interests; the display of frost and cold-wave signals; the distribution of meteorological information in the interests of agriculture and commerce; and the taking of such meteorological observations as may be necessary to establish and record the climatic conditions of the United States, or as are essential for the proper execution of the foregoing duties.

BUREAU OF ANIMAL INDUSTRY.—*Chief*, D. E. Salmon; *Assistant Chief*, A. D. Melvin; *Chief Clerk*, E. B. Jones; *Chief of Inspection Division*, A. M. Farrington; *Chief of Quarantine Division*, Richard W. Hickman; *Chief of Pathological Division*, John R. Mohler; *Chief of Biochemic Division*, M. Dorset; *Chief of Dairy Division*, Ed. H. Webster; *Acting Zoologist*, B. H. Ransom; *In charge of Experiment Station*, E. C. Schroeder; *Editor*, George F. Thompson; *Animal Husbandman*, George M. Rommel.

The Bureau of Animal Industry makes investigations as to the existence of dangerous communicable diseases of live stock, superintends the measures for their extirpation, makes original investigations as to the nature and prevention of such diseases, and reports on the condition and the means of improving the animal industries of the country. It also has charge of the inspection of import and export animals, of the inspection of vessels for the transportation of export cattle, and of the quarantine stations for imported neat cattle; supervises the interstate movement of cattle, and inspects live stock and their products when offered for food consumption; has supervision of manufacture, interstate commerce, and export of renovated butter.

BUREAU OF PLANT INDUSTRY.—*Chief*, Beverly T. Galloway; *Pathologist and Physiologist, and Acting Chief in absence of Chief*, A. F. Woods; *Chief Clerk*, James E. Jones; *Editor*, J. E. Rockwell; *Botanist*, F. V. Coville; *Agrostologist*, W. J. Spillman; *Pomologist*, G. B. Brackett; *Botanist in charge of Seed and Plant Introduction and Distribution*, A. J. Pieters; *Horticulturist*, L. C. Corbett; *Superintendent of Experimental Gardens and Grounds*, E. M. Byrnes.

The Bureau of Plant Industry studies plant life in all its relations to agriculture. It includes Vegetable Pathological and Physiological Investigations; Botanical Investigations and Experiments; Grass and Forage Plant Investigations; Pomological Investigations; Experimental Gardens and Grounds; the Arlington Experimental Farm; Congressional Seed Distribution; Seed and Plant Introduction; Tea Culture Experiments; and Investigation of Production of Domestic Sugar.

BUREAU OF FORESTRY (Atlantic Building, 928–930 F street NW.).—*Forester and Chief*, Gifford Pinchot; *Associate Forester and in charge of Forest Measurements*, Overton W. Price; *In charge of Forest Management*, Thomas H. Sherrard; *In charge of Forest Reserves*, Frederick E. Olmsted; *In charge of Dendrology*, George B. Sudworth; *In charge of Forest Extension*, Ernest A. Sterling; *In charge of Forest Products*, William L. Hall; *In charge of Records*, James B. Adams.

The Bureau of Forestry has charge of the administration of the national forest reserves, and conducts examinations on the public lands to determine the propriety of making changes in the boundaries of existing national forest reserves and of withdrawing other areas suitable for new reserves; gives practical assistance in the conservative handling of State and private forest lands; investigates methods of planting and kinds of trees for planting, and gives practical assistance to tree planters; studies commercially valuable trees to determine the best means of using and reproducing them; tests the strength and durability of construction timbers, railroad ties, and poles, and determines the best methods of extending their life through preservative treatment; and studies forest fires, the effects of grazing on forest land, turpentine orcharding, and other forest problems.

BUREAU OF CHEMISTRY (corner Fourteenth and B streets SW.).—*Chemist and Chief*, Harvey W. Wiley; *Chief, Division of Foods*, W. D. Bigelow; *Sugar Laboratory* under direction of Chief of Bureau; *Chief, Division of Tests*, L. W. Page; *Chief, Insecticide and Agricultural Water Laboratory*, J. K. Haywood; *Chief, Dairy Laboratory*, G. E. Patrick; *Chief, Plant Analysis Laboratory*, C. C. Moore; *Chief, Drug Laboratory*, L. F. Kebler; *Chief, Contracts Laboratory*, L. S. Munson; *Chief, Microchemical Laboratory*, B. J. Howard; *Chief, Leather and Paper Laboratory*, F. P. Veitch; *Chief Clerk*, M. S. Tidd.

The Bureau of Chemistry investigates methods proposed for the analysis of plants, fertilizers, and agricultural products, and makes such analyses as pertain in general to the interests of agriculture. The work on foods includes the analysis of adulterated products, experiments to determine the effect of adulterants on the human organism, and the investigation of food products imported into the United States. The Bureau does chemical work for some of the other Bureaus and Divisions of the Department, and for other departments of the Government which apply to the Secretary of Agriculture for such assistance.

BUREAU OF SOILS (212–214 Thirteenth street SW.).—*Chief*, Milton Whitney; *Chief Clerk*, A. G. Rice; *Soil Physicist*, Lyman J. Briggs; *Soil Chemist*, Frank K. Cameron; *In charge of Soil Survey*, George N. Coffey; *In charge of Alkali Reclamation Investigations*, Clarence W. Dorsey; *Tobacco Expert*, George T. McNess.

The Bureau of Soils is intrusted with the investigation, survey, and mapping of soils; the investigation of the cause and prevention of the rise of alkali in the soil, and the drainage of soils; and the investigation of the methods of growing, curing, and fermentation of tobacco in the different tobacco districts.

BUREAU OF ENTOMOLOGY.—*Entomologist and Chief*, L. O. Howard; *In charge of Experimental Field Work*, C. L. Marlatt; *In charge of Breeding Experiments*, F. H. Chittenden; *In charge of Forest Insect Investigations*, A. D. Hopkins; *In charge of Apiculture*, Frank Benton; *In charge of Cotton Boll Weevil Investigations*, W. D. Hunter; *In charge of Deciduous Fruit Insect Investigations*, A. L. Quaintance; *Chief Clerk*, R. S. Clifton.

The Bureau of Entomology obtains and disseminates information regarding injurious insects affecting field crops, fruits, small fruits, and truck crops, forest and forest products, and stored products; studies insects in relation to diseases of man and other animals and as animal parasites; experiments with the introduction of beneficial insects and with the fungous and other diseases of insects; and conducts experiments and tests with insecticides and insecticide machinery. It is further charged with investigations in apiculture and sericulture. The information gained is disseminated in the form of general reports, bulletins, and circulars. A good deal of museum work is done in connection with the Division of Insects of the National Museum, and insects are identified for experiment stations and other public institutions and private individuals.

BUREAU OF BIOLOGICAL SURVEY.—*Biologist and Chief*, C. Hart Merriam; *Assistant Chief*, A. K. Fisher; *Assistant in charge of Game Preservation*, T. S. Palmer; *Assistant in charge of Economic Ornithology*, F. E. L. Beal.

The Division of Biological Survey studies the geographic distribution of animals and plants, and maps the natural life zones of the country; it also investigates the economic relations of birds and mammals, and recommends measures for the preservation of beneficial and the destruction of injurious species. It is charged with carrying into effect the provisions of the Federal law for the importation and protection of birds and certain provisions of the law for the protection of game in Alaska.

DIVISION OF ACCOUNTS AND DISBURSEMENTS.—*Chief and Disbursing Clerk*, Frank L. Evans; *Assistant Chief* (in charge of Weather Bureau disbursements), A. Zappone; *Cashier*, M. E. Fagan.

The Division of Accounts and Disbursements audits, adjusts, and pays all accounts and claims against the Department; decides questions involving the expenditure of public funds; prepares advertisements, schedules, contracts for annual supplies, leases, agreements, bonds, and letters of authority; writes, for the signature of the Secretary, all letters to the Treasury Department pertaining to fiscal matters and all letters to the Department of Justice; attends to litigation in which the Department is interested; issues requisitions for the purchase of supplies and requests for passenger and for freight transportation; prepares the annual estimates of appropriations; and transacts all other business relating to the financial interests of the Department.

DIVISION OF PUBLICATIONS.—*Editor and Chief*, Geo. Wm. Hill; *Associate Editor*, Joseph A. Arnold; *Assistant Editor*, B. D. Stallings; *Assistant in charge of Document Section*, R. B. Handy; *Assistant in charge of Illustrations*, Louis S. Williams.

The Division of Publications exercises general supervision of the Department printing and illustrations, edits all publications of the Department (with the exception of those of the Weather Bureau), has charge of the printing and Farmers' Bulletin

funds, and distributes all Department publications with the exception of those turned over by law to the Superintendent of Documents for sale at the price affixed by him; it issues, in the form of press notices, official information of interest to agriculturists, and distributes to agricultural publications and writers notices and synopses of Department publications; and has charge of all correspondence with the Government Printing Office.

BUREAU OF STATISTICS.—*Statistician and Chief*, John Hyde; *Associate Statistician*, Edwin S. Holmes, jr.; *Assistant Statistician and Assistant Chief*, Stephen D. Fessenden; *Chief Clerk*, C. C. Clark; *Chief, Division of Foreign Markets*, George K. Holmes; *Chief, Division of Domestic Crop Reports*, Victor H. Olmsted.

The Statistician collects information as to the condition, production, etc., of the principal crops and the status of farm animals through State agents, each of whom is assisted by a corps of local reporters, through separate corps of county, township, and cotton correspondents, through traveling agents, and through a special foreign correspondent, assisted by consular, agricultural, and commercial authorities. He records, tabulates, and coordinates statistics of agricultural production, distribution, and consumption, the authorized data of governments, institutes, societies, boards of trade, and individual experts; prepares special statistical bulletins upon agricultural subjects, and issues a monthly crop report for the information of producers and consumers. Through the division of foreign markets, which has for its object the extension of the agricultural export trade of the United States, the Statistician investigates the requirements of foreign markets, studies the conditions of demand and supply as disclosed by the records of production, importation, and exportation; inquires into the obstacles confronting trade extension, and disseminates, through printed reports and otherwise, the information collected.

LIBRARY.—*Librarian*, Josephine A. Clark; *Assistant Librarian*, Claribel R. Barnett.

The Librarian has charge of the Library and supervises the arrangement and cataloguing of books, the preparation of bibliographies and similar publications, and the purchase of new books. The mailing lists for the distribution of Department publications to foreign countries are under the supervision of the Librarian.

OFFICE OF EXPERIMENT STATIONS.—*Director*, A. C. True; *Assistant Director and Editor of Experiment Station Record*, E. W. Allen; *Chief of Editorial Division*, W. H. Beal; *Chief of Division of Insular Stations*, W. H. Evans; *Special Agent, Alaska*, C. C. Georgeson; *Special Agent, Hawaii*, Jared G. Smith; *Special Agent, Porto Rico*, D. W. May; *Chief of Nutrition Investigations*, W. O. Atwater; *Chief of Irrigation and Drainage Investigations*, Elwood Mead; *Farmers' Institute Specialist*, John Hamilton; *Chief Clerk*, Mrs. C. E. Johnston.

The Office of Experiment Stations represents the Department in its relation to the experiment stations, which are now in operation in all the States and Territories, and directly manages the experiment stations in Alaska, Porto Rico, and Hawaii. It seeks to promote the interests of agricultural education and investigation throughout the United States. It collects and disseminates general information regarding the colleges and stations, and publishes accounts of agricultural investigations at home and abroad. It also indicates lines of inquiry for the stations, aids in the conduct of cooperative experiments, reports upon their expenditures and work, and in general furnishes them with such advice and assistance as will best promote the purposes for which they were established. In a similar way it aids in the development of the farmers' institutes throughout the United States. It is charged with investigations on the nutritive value and economy of human foods. It conducts investigations of the laws and institutions relating to irrigation in different regions, the use of irrigation waters, the removal of seepage and surplus waters by drainage, and the use of different kinds of power and machinery for irrigation and other agricultural purposes.

OFFICE OF PUBLIC ROADS.—*Director*, Martin Dodge; *Assistant Director*, Logan Waller Page.

The Office of Public Road Inquiries collects and disseminates information concerning the systems of road management throughout the United States, conducts investigations and experiments regarding the best method of road making, the best kinds of road-making materials, and prepares publications on these subjects. It also makes tests of all kinds of road-building materials in the laboratory at Washington for any citizen of the United States, free of expense, and cooperates with local communities in building object-lesson roads.

APPROPRIATIONS FOR THE DEPARTMENT OF AGRICULTURE FOR THE FISCAL YEARS ENDING JUNE 30, 1903, 1904, AND 1905.

Object of appropriation.	1903.	1904.	1905.
Salaries, Department of Agriculture	$465,500.00	$471,080.00	$482,300.00
Library, Department of Agriculture	8,000.00	10,000.00	10,000.00
Contingent Expenses, Department of Agriculture	[a] 43,000.00	37,000.00	37,000.00
Collecting Agricultural Statistics	94,200.00	109,200.00	139,500.00
Botanical Investigations and Experiments	55,000.00	65,000.00	67,500.00
Entomological Investigations	45,500.00	65,500.00	70,000.00
Vegetable Pathological Investigations	110,000.00	130,000.00	150,000.00
Rent of Quarters, Plant Bureau (deficiency act)	....	....	2,500.00
Biological Investigations	28,000.00	34,000.00	34,000.00
Pomological Investigations	30,000.00	37,000.00	43,500.00
Laboratory, Department of Agriculture	60,500.00	70,500.00	135,000.00
Forestry Investigations	254,000.00	312,860.00	388,000.00
Testing Timbers, Louisiana Purchase Exposition, St. Louis, Mo. (deficiency act)	....	....	10,000.00
Experimental Gardens and Grounds, Department of Agriculture	25,000.00	25,000.00	25,000.00
Soil Investigations	130,000.00	170,000.00	170,000.00
Grass and Forage Plant Investigations	30,000.00	35,000.00	42,500.00
Greenhouses, Department of Agriculture, 1904–1905	....	....	25,000.00
Agricultural Experiment Stations [for stations under Hatch Act, $796,000, 1903; $810,000, 1904; $810,000, 1905]	[b] 76,000.00	[b] 90,000.00	[b] 90,000.00
Nutrition Investigations	20,000.00	20,000.00	20,000.00
Public Road Inquiries	30,000.00	35,000.00	35,000.00
Cotton Boll Investigations	....	170,000.00	250,000.00
Publications, Department of Agriculture	[c] 204,000.00	200,000.00	210,000.00
Sugar Investigations	5,000.00	5,000.00	7,500.00
Purchase and Distribution of Valuable Seeds	270,000.00	290,000.00	290,000.00
Salaries and Expenses, Bureau of Animal Industry	[d] 1,660,000.00	1,450,000.00	1,525,000.00
Irrigation Investigations	65,000.00	65,000.00	67,500.00
Tea Culture Investigations	10,000.00	10,000.00	10,000.00
Arlington Experimental Farm	15,000.00	15,000.00	20,000.00
Foreign Market Investigations	6,500.00	7,500.00	....
Silk Investigations	10,000.00	....	....
Building, Department of Agriculture	....	250,000.00	250,000.00
Total	3,750,200.00	4,179,640.00	4,606,800.00
WEATHER BUREAU.			
Salaries, Weather Bureau	165,260.00	175,440.00	180,440.00
Fuel, Lights, and Repairs, Weather Bureau	10,000.00	6,000.00	8,000.00
Contingent Expenses, Weather Bureau	8,000.00	8,000.00	10,000.00
General Expenses, Weather Bureau	915,500.00	969,080.00	1,064,300.00
Meteorological Observation Stations	60,000.00	....	....
Buildings, Weather Bureau	50,000.00	50,000.00	48,000.00
Cables and Land Lines, Weather Bureau	40,000.00	40,000.00	27,000.00
Storm-warning Stations, Glenhaven and South Manitou Island, Mich., Weather Bureau	15,000.00	....	....
Total, Weather Bureau	1,263,760.00	1,248,520.00	1,337,740.00
Grand total	5,013,960.00	5,428,160.00	5,944,540.00

[a] Includes $6,000 deficiency.
[b] Expenses of Office of Experiment Stations.
[c] Includes $4,000 deficiency, but does not include $300,000 for Yearbook and $185,000 in general fund.
[d] Includes $500,000 deficiency, emergency fund for foot-and-mouth disease.

AGRICULTURAL COLLEGES AND OTHER INSTITUTIONS IN THE UNITED STATES HAVING COURSES IN AGRICULTURE.[a]

College instruction in agriculture is given in the colleges and universities receiving the benefits of the acts of Congress of July 2, 1862, and August 30, 1890, which are now in operation in all the States and Territories, except Alaska, Hawaii, and Porto Rico. The total number of these institutions is 65, of which 63 maintain courses of instruction in agriculture. In 21 States the agricultural colleges are departments of the State universities. In 15 States and Territories separate institutions having courses in agriculture are maintained for the colored race. All of the agricultural colleges for white persons and several of those for negroes offer four-year courses in agriculture and its related sciences leading to bachelors' degrees, and many provide for graduate study. About 45 of these institutions also provide special, short, and

[a] Including only institutions established under the land-grant act of July 2, 1862.

correspondence courses in the different branches of agriculture, including agronomy, horticulture, animal husbandry, poultry culture, cheese making, dairying, sugar making, rural engineering, farm mechanics, and other technical subjects. The officers of the agricultural colleges engage quite largely in conducting farmers' institutes and various other forms of college extension. The agricultural experiment stations with very few exceptions are departments of the agricultural colleges. The total number of persons engaged in the work of education and research in the land-grant colleges and the experiment stations in 1904 was 4,666; the number of students in these colleges, 56,226; the number of students in the four-year college courses in agriculture, 4,640; in short and special courses, 5,281. With a few exceptions each of these colleges offers free tuition to residents of the States in which it is located. In the excepted cases scholarships are open to promising and energetic students; and in all opportunities are found for some to earn part of their expenses by their own labor. The expenses are from $125 to $300 for the school year.

Agricultural colleges and other institutions in the United States having courses in agriculture.

States and Territories.	Name of institution.	Location.	President.
Alabama	Alabama Polytechnic Institute	Auburn	C. C. Thach, M. A.
	Agricultural and Mechanical College for Negroes.	Normal	W. H. Councill, Ph. D.
Arizona	University of Arizona	Tucson	K. C. Babcock, Ph. D.
Arkansas	University of Arkansas	Fayetteville	H. S. Hartzog, LL. D.
California	University of California	Berkeley	B. I. Wheeler, LL. D.
Colorado	The State Agricultural College of Colorado.	Fort Collins	B. O. Aylesworth, LL. D.
Connecticut	Conn. Agricultural College	Storrs	R. W. Stimson, M. A.
Delaware	Delaware College	Newark	G. A. Harter, Ph. D.
	State College for Colored Students.	Dover	W. C. Jason, M. A.
Florida	University of Florida	Lake City	Andrew Sledd, Ph. D.
	Florida State Normal and Industrial College.	Tallahassee	N. B. Young, M. A.
Georgia	Georgia State College of Agriculture and Mechanic Arts.	Athens	H. C. White, Ph. D.
	Georgia State Industrial College.	College	R. R. Wright, LL. D.
Idaho	University of Idaho	Moscow	J. A. MacLean, Ph. D.
Illinois	University of Illinois	Urbana	E. J. James, LL. D.
Indiana	Purdue University	Lafayette	W. E. Stone, Ph. D.
Iowa	Iowa State College of Agriculture and the Mechanic Arts.	Ames	A. B. Storms, D. D.
Kansas	Kansas State Agricultural College.	Manhattan	E. R. Nichols, M. A.
Kentucky	Agricultural and Mechanical College of Kentucky.	Lexington	J. K. Patterson, LL. D.
	The Kentucky Normal and Industrial Institute for Colored Persons.	Frankfort	J. S. Hathaway, M. A., M. D.
Louisiana	Louisiana State University and Agricultural and Mechanical College.	Baton Rouge	T. D. Boyd, LL. D.
	Southern University and Agricultural and Mechanical College.	New Orleans	H. A. Hill.
Maine	The University of Maine	Orono	G. E. Fellows, LL. D.
Maryland	Maryland Agricultural College	College Park	R. W. Silvester.
	Princess Anne Academy, Eastern Branch, Md. Agr. Coll.	Princess Anne	F. Trigg, M. A.
Massachusetts	Massachusetts Agricultural College	Amherst	H. H. Goodell, LL. D.
Michigan	Michigan State Agricultural College.	Agricultural College.	J. L. Snyder, Ph. D.
Minnesota	The University of Minnesota	St. Anthony Park	C. Northrop, LL. D.
Mississippi	Mississippi Agricultural and Mechanical College.	Agricultural College.	J. C. Hardy, LL. D.
	Alcorn Agricultural and Mechanical College.	Westside	W. H. Lanier, B. A.
Missouri	The University of Missouri	Columbia	R. H. Jesse, LL. D.
	Lincoln Institute	Jefferson City	B. F. Allen, LL. D.
Montana	The Montana College of Agriculture and Mechanic Arts.	Bozeman	J. M. Hamilton.
Nebraska	The University of Nebraska	Lincoln	E. B. Andrews, LL. D.
Nevada	Nevada State University	Reno	J. E. Stubbs, M. A., D. D.
New Hampshire	The New Hampshire College of Agriculture and the Mechanic Arts.	Durham	W. D. Gibbs, M. S.

Agricultural colleges and other institutions in the United States having courses in agriculture—Continued.

States and Territories.	Name of institution.	Location.	President.
New Jersey	Rutgers Scientific School (The New Jersey State College for the Benefit of Agriculture and the Mechanic Arts).	New Brunswick	Austin Scott, LL. D.
New Mexico	The New Mexico College of Agriculture and Mechanic Arts.	Mesilla Park	Luther Foster, M. S. A.
New York	Cornell University	Ithaca	J. G. Schurman, LL. D.
North Carolina	The North Carolina College of Agriculture and Mechanic Arts.	West Raleigh	G. T. Winston, LL. D.
	The Agricultural and Mechanical College for the Colored Race.	Greensboro	J. B. Dudley, M. A.
North Dakota	North Dakota Agricultural College.	Agricultural College.	J. H. Worst, LL. D.
Ohio	Ohio State University	Columbus	W. O. Thompson, D. D.
Oklahoma	Oklahoma Agricultural and Mechanical College.	Stillwater	A. C. Scott, LL. M.
	Agricultural and Normal University.	Langston	I. E. Page, M. A.
Oregon	Oregon State Agricultural College.	Corvallis	T. M. Gatch, Ph. D.
Pennsylvania	The Pennsylvania State College.	State College	G. W. Atherton, LL. D.
Rhode Island	Rhode Island College of Agriculture and Mechanic Arts.	Kingston	K. L. Butterfield, A. M.
South Carolina	Clemson Agricultural College of South Carolina.	Clemson College	P. H. Mell, Ph. D.
	The Colored Normal, Industrial, Agricultural, and Mechanical College of South Carolina.	Orangeburg	T. E. Miller, LL. D.
South Dakota	South Dakota Agricultural College.	Brookings	James Chalmers, Ph. D.
Tennessee	University of Tennessee	Knoxville	Brown Ayres, LL. D.
Texas	Agricultural and Mechanical College of Texas.	College Station	D. F. Houston, LL. D.
	Prairie View State Normal and Industrial College.	Prairie View	E. L. Blackshear.
Utah	The Agricultural College of Utah.	Logan	W. J. Kerr, D. Sc.
Vermont	University of Vermont and State Agricultural College.	Burlington	M. H. Buckham, LL. D.
Virginia	The Virginia Agricultural and Mechanical College and Polytechnic Institute.	Blacksburg	J. M. McBryde, LL. D.
	The Hampton Normal and Agricultural Institute.	Hampton	H. B. Frissell, LL. D.
Washington	Washington Agricultural College and School of Science.	Pullman	E. A. Bryan, LL. D.
West Virginia	West Virginia University	Morgantown	D. B. Purinton, LL. D.
	The West Virginia Colored Institute.	Institute	J. McH. Jones, A. M.
Wisconsin	University of Wisconsin	Madison	C. R. Van Hise, Ph. D.
Wyoming	University of Wyoming	Laramie	F. M. Tisdel, Ph. D.

AGRICULTURAL EXPERIMENT STATIONS OF THE UNITED STATES, THEIR LOCATIONS, DIRECTORS, AND PRINCIPAL LINES OF WORK.

Stations, locations, and directors.	Principal lines of work.
Alabama (College), Auburn: J. F. Duggar	Botany; soils: analyses of fertilizers and food materials; agronomy; horticulture; plant breeding; diseases of plants and animals; animal husbandry; dairying.
Alabama (Canebrake), Uniontown: J. M. Richeson [a]	Agronomy; horticulture; floriculture; diseases of plants and animals.
Alabama (Tuskegee), Tuskegee Institute: G. W. Carver	Agronomy; horticulture; diseases of plants; animal industry; dairying.
Arizona, Tucson: R. H. Forbes	Chemistry; botany; agronomy; horticulture; animal husbandry; dairying; irrigation.
Arkansas, Fayetteville: W. G. Vincenheller	Chemistry; agronomy; horticulture; plant breeding; diseases of plants and animals; animal husbandry; entomology.
California, Berkeley: E. W. Hilgard	Chemistry; soils; bacteriology; fertilizer control; agronomy; horticulture, including viticulture and zymology; botany; meteorology; animal husbandry; entomology; dairying; poultry experiments; drainage and irrigation; sylviculture; reclamation of alkali lands; animal and plant pathology; nutrition investigations.
Colorado, Fort Collins: L. G. Carpenter	Chemistry; meteorology; agronomy; horticulture; plant breeding; diseases of plants; animal husbandry; entomology; irrigation.
Connecticut (State), New Haven: E. H. Jenkins	Chemistry; inspection of fertilizers, foods, feeding stuffs, Babcock test apparatus, and nurseries; diseases of plants; horticulture; forestry; agronomy; entomology.
Connecticut (Storrs), Storrs: L. A. Clinton	Food and nutrition of man and animals; dairy bacteriology; agronomy; horticulture; poultry culture; dairying.
Delaware, Newark: A. T. Neale	Chemistry; bacteriology; agronomy; horticulture; plant breeding; diseases of plants and animals; animal husbandry; entomology; dairying.
Florida, Lake City: Andrew Sledd	Chemistry; agronomy; horticulture; feeding experiments; veterinary science; entomology.
Georgia, Experiment: R. J. Redding	Agronomy; horticulture; entomology; animal husbandry; dairying.
Idaho, Moscow: H. T. French	Chemistry; physics; botany; agronomy; horticulture; plant breeding; entomology; animal husbandry.
Illinois, Urbana: E. Davenport	Chemistry; bacteriology; agronomy; horticulture; forestry; plant breeding; diseases of plants and animals; animal husbandry; entomology; dairying.
Indiana, Lafayette: Arthur Goss	Chemistry; agronomy; horticulture; animal husbandry; diseases of plants and animals; entomology; irrigation; dairying.
Iowa, Ames: C. F. Curtiss	Chemistry; botany; agronomy; horticulture; plant breeding; forestry; diseases of plants; animal husbandry; entomology; dairying; rural engineering; good roads investigations.
Kansas, Manhattan: J. T. Willard	Soils; horticulture; plant breeding; agronomy; animal husbandry; diseases of animals; entomology; dairying; extermination of prairie dogs and gophers.
Kentucky, Lexington: M. A. Scovell	Chemistry; soils; inspection of fertilizers, foods, feeding stuffs, orchards, and nurseries; agronomy; horticulture; plant breeding; animal husbandry; diseases of plants; entomology; dairying.
Louisiana (Sugar), New Orleans: W. R. Dodson	Chemistry; bacteriology; soils; agronomy; horticulture; sugar making; drainage; irrigation.
Louisiana (State), Baton Rouge: W. R. Dodson	Geology; botany; bacteriology; soils; inspection of fertilizers and Paris green; agronomy; horticulture; animal husbandry; diseases of animals; entomology.
Louisiana (North), Calhoun: W. R. Dodson	Chemistry; soils; fertilizers; agronomy; horticulture; animal husbandry; stock raising; dairying.

[a] Assistant director.

Agricultural experiment stations of the United States, their locations, directors, and principal lines of work—Continued.

Stations, locations, and directors.	Principal lines of work.
Maine, Orono: C. D. Woods	Chemistry; botany; inspection of fertilizers, commercial feeding stuffs, and creamery glassware; horticulture; plant breeding; diseases of plants and animals; food and nutrition of man and animals; poultry raising; entomology; dairying.
Maryland, College Park: H. J. Patterson	Chemistry; agronomy; horticulture; diseases of plants and animals; breeding of plants; animal husbandry; entomology; dairying.
Massachusetts, Amherst: H. H. Goodell	Chemistry; meteorolgy; inspection of fertilizers, commercial feeding stuffs, creamery glassware, and nurseries; agronomy; horticulture; diseases of plants and animals; animal husbandry; entomology; dairying; effect of electricity on plant growth.
Michigan, Agricultural College: C. D. Smith	Chemistry; bacteriology; soils; agronomy; horticulture; plant breeding; diseases of plants and animals; animal husbandry; entomology; stable hygiene.
Minnesota, St. Anthony Park, St. Paul: W. M. Liggett	Chemistry; fertilizers; agronomy; horticulture; forestry; diseases of plants and animals; food and nutrition investigations; plant and animal breeding; animal husbandry; entomology; dairying; farm management; farm statistics.
Mississippi, Agricultural College: W. L. Hutchinson	Soils; fertilizers; agronomy; horticulture; animal husbandry; diseases of animals; poultry culture; entomology; dairying.
Missouri (College), Columbia: F. B. Mumford [a]	Chemistry; botany; agronomy; horticulture; diseases of plants and animals; animal husbandry; plant breeding; entomology; dairying; drainage and irrigation.
Missouri (Fruit), Mountain Grove: Paul Evans	Horticulture; entomology; inspection of orchards and nurseries.
Montana, Bozeman: F. B. Linfield	Chemistry; meteorology; botany; agronomy; horticulture; animal husbandry; poultry experiments; entomology; dairying; irrigation.
Nebraska, Lincoln: E. A. Burnett	Chemistry; botany; meteorology; soils; agronomy; horticulture; diseases of plants and animals; forestry; animal husbandry; entomology; dairying; irrigation; extermination of prairie dogs.
Nevada, Reno: J. E. Stubbs	Chemistry; botany; soils; agronomy; horticulture; forestry; animal diseases; entomology; irrigation.
New Hampshire, Durham: W. D. Gibbs	Chemistry; agronomy; horticulture; forestry; animal husbandry; entomology; dairying.
New Jersey (State), New Brunswick: E. B. Voorhees New Jersey (College), New Brunswick: E. B. Voorhees	Chemistry; oyster culture; botany; analysis of fertilizers, foods, and commercial feeding stuffs; agronomy; horticulture; plant breeding; diseases of plants and animals; entomology; dairy husbandry; soil bacteriology; irrigation.
New Mexico, Mesilla Park: Luther Foster	Chemistry; botany; agronomy; horticulture; animal husbandry; entomology; irrigation.
New York (State), Geneva: W. H. Jordan	Chemistry; bacteriology; meteorology; inspection of creamery glassware, feeding stuffs, fertilizers, and Paris green; agronomy; horticulture; plant breeding; diseases of plants; animal husbandry; poultry experiments; entomology; dairying; irrigation.
New York (Cornell), Ithaca: L. H. Bailey	Chemistry; fertilizers; agronomy; horticulture; diseases of plants and animals; animal husbandry; poultry experiments; entomology; dairying.
North Carolina, Raleigh: B. W. Kilgore	Chemistry; soils; agronomy; horticulture; animal husbandry; diseases of animals and plants; poultry experiments; dairying; tests of farm machinery.
North Dakota, Agricultural College: J. H. Worst	Chemistry; botany; agronomy; plant breeding; horticulture; diseases of plants and animals; food analysis; animal husbandry; dairying; farm mechanics.
Ohio, Wooster: C. E. Thorne	Agronomy; horticulture; plant breeding; diseases of plants and animals; animal husbandry; entomology.

[a] Acting director.

Agricultural experiment stations of the United States, their locations, directors, and principal lines of work—Continued.

Stations, locations, and directors.	Principal lines of work.
Oklahoma, Stillwater: John Fields	Chemistry; agronomy; horticulture; plant breeding; forestry; botany; diseases of plants and animals; animal husbandry; entomology.
Oregon, Corvallis: J. Withycombe	Chemistry; bacteriology; agronomy; horticulture; plant selection; diseases of plants; animal husbandry; entomology; dairying; irrigation.
Pennsylvania, State College: H. P. Armsby	Chemistry; meteorology; analysis of fertilizers, foods, and feeding stuffs; horticulture; agronomy; animal husbandry; dairying.
Rhode Island, Kingston: H. J. Wheeler	Chemistry; meteorology; soils; inspection of fertilizers and feeding stuffs; agronomy; horticulture; plant breeding; poultry experiments.
South Carolina, Clemson College: P. H. Mell	Chemistry; inspection of fertilizers; botany; agronomy; horticulture; plant breeding; diseases of plants; animal husbandry; veterinary science; entomology; dairying.
South Dakota, Brookings: J. W. Wilson	Chemistry; botany; agronomy; horticulture; plant breeding; diseases of plants and animals; animal husbandry; entomology; irrigation.
Tennessee, Knoxville: H. A. Morgan	Chemistry; inspection of fertilizers; agronomy; horticulture; plant breeding; seeds; weeds; diseases of plants; animal husbandry; entomology; dairying.
Texas, College Station: J. A. Craig	Chemistry; soils; agronomy; horticulture; animal husbandry; diseases of animals; irrigation.
Utah, Logan: J. A. Widtsoe	Chemistry; alkali soil investigations; agronomy; horticulture; diseases of plants; animal husbandry; dairying; poultry experiments; entomology; irrigation.
Vermont, Burlington: J. L. Hills	Chemistry; botany; inspection of fertilizers, feeding stuffs, and creamery glassware; agronomy; horticulture; diseases of plants; animal husbandry; dairying.
Virginia, Blacksburg: A. M. Soule	Chemistry; geology; biology; agronomy; horticulture; bacteriology; analysis of foods and soils; feeding experiments; veterinary science; entomology; cider and vinegar making; ferments.
Washington, Pullman: E. A. Bryan	Chemistry; botany; bacteriology; agronomy; horticulture; plant breeding; diseases of plants and animals; animal husbandry; entomology; dairying; irrigation.
West Virginia, Morgantown: J. H. Stewart	Chemistry; inspection of fertilizers, orchards, and nurseries; agronomy; horticulture; diseases of plants; animal husbandry; poultry experiments; entomology.
Wisconsin, Madison: W. A. Henry	Chemistry; bacteriology; soils; agronomy; horticulture; animal husbandry; dairying; drainage and irrigation; farm engineering.
Wyoming, Laramie: B. C. Buffum	Botany; meteorology; soils; range improvement; fertilizers; agronomy; food analysis; animal husbandry; irrigation.

ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

President, E. B. Voorhees, director New Jersey Experiment Stations, New Brunswick, N. J.; secretary-treasurer, J. L. Hills, director Vermont Experiment Station, Burlington, Vt.

OFFICIALS IN CHARGE OF FARMERS' INSTITUTES.

Farmers' Institute Specialist, Department of Agriculture.

John Hamilton, Washington, District of Columbia.

State superintendents.

States and Territories.	Name of official.	Post-office.
Alabama	C. A. Cary, Alabama Polytechnic Institute	Auburn.
	G. W. Carver, Director Agricultural Experiment Station	Tuskegee Institute.
Alaska	C. C. Georgeson, Agricultural Experiment Station	Sitka.
Arizona	R. H. Forbes, Director Agricultural Experiment Station	Tucson.
Arkansas	H. S. Hartzog, President University of Arkansas	Fayetteville.
California	E. J. Wickson, University of California	Berkeley.
Colorado	A. M. Hawley, Secretary State Board of Agriculture	Fort Collins.
Connecticut	J. F. Brown, Secretary State Board of Agriculture	N. Stonington.
	J. O. Noble, Secretary Connecticut Dairymen's Association	Hartford.
	H. C. C. Miles, Secretary Connecticut Pomological Society	Milford.
Delaware	Wesley Webb, Director of Farmers' Institutes	Dover.
Florida	C. M. Conner, University of Florida	Lake City.
Georgia	H. C. White, President State College of Agriculture	Athens.
	Harvie Jordan, Director of Farmers' Institutes	Monticello.
Hawaii	J. G. Smith, Agricultural Experiment Station	Honolulu.
Idaho	H. T. French, Director Agricultural Experiment Station	Moscow.
Illinois	A. B. Hostetter, Secretary Farmers' Institutes	Springfield.
Indiana	W. C. Latta, Purdue University	Lafayette.
Iowa	J. C. Simpson, Secretary State Board of Agriculture	Des Moines.
Kansas	J. T. Willard, Director Agricultural Experiment Station	Manhattan.
Kentucky	Hubert Vreeland, Commissioner of Agriculture	Frankfort.
Louisiana	J. G. Lee, Commissioner of Agriculture	Baton Rouge.
Maine	A. W. Gilman, Commissioner of Agriculture	Augusta.
Maryland	W. L. Amoss, Director Farmers' Institutes	Benson.
Massachusetts	J. L. Ellsworth, Secretary State Board of Agriculture	Boston.
Michigan	L. R. Taft, Director Farmers' Institutes	Agricultural College.
Minnesota	O. C. Gregg, Director Farmers' Institutes	Lynd.
Mississippi	J. C. Hardy, President Ag'l and Mechanical College	Agricultural College.
Missouri	Geo. B. Ellis, Secretary State Board of Agriculture	Columbia.
Montana	F. B. Linfield, Director Agr. Experiment Station	Bozeman.
Nebraska	E. A. Burnett, Director Agricultural Experiment Station	Lincoln.
Nevada	J. E. Stubbs, President Nevada State University	Reno.
New Hampshire	N. J. Bachelder, Secretary State Board of Agriculture	Concord.
New Jersey	Franklin Dye, Secretary State Board of Agriculture	Trenton.
New Mexico	Luther Foster, President Ag'l and Mechanical College	Mesilla Park.
New York	F. E. Dawley, Director of Farmers' Institutes	Fayetteville.
North Carolina	S. L. Patterson, Commissioner of Agriculture	Raleigh.
North Dakota	E. E. Kaufman, Director Farmers' Institutes	Bismarck.
Ohio	W. W. Miller, Secretary State Board of Agriculture	Columbus.
Oklahoma	J. B. Thoburn, Secretary Board of Agriculture	Guthrie.
Oregon	J. Withycombe, Director Agricultural Experiment Station	Corvallis.
Pennsylvania	A. L. Martin, Deputy Secretary of Agriculture	Harrisburg.
Porto Rico	W. H. Elliott, Director of Farmers' Institutes	San Juan.
Rhode Island	John G. Clarke, Secretary State Board of Agriculture	Providence.
South Carolina	J. S. Newman, Director Farmers' Institutes	Clemson College.
	Thos. E. Miller, President A. and M. College	Orangeburg.
South Dakota	James W. Wilson, Director Agr. Experiment Station	Brookings.
Tennessee	W. W. Ogilvie, Commissioner of Agriculture	Nashville.
Texas	J. W. Carson, Director Farmers' Institutes	College Station.
Utah	John A. Widtsoe, Director Agr. Experiment Station	Logan.
Vermont	Geo. Aitken, Secretary State Board of Agriculture	Woodstock.
Virginia	G. W. Koiner, Commissioner of Agriculture	Richmond.
Washington	E. A. Bryan, President Agricultural College	Pullman.
West Virginia	J. B. Garvin, Director of Institutes	Charleston.
Wisconsin	G. McKerrow, Director Farmers' Institutes	Madison.
Wyoming	B. C. Buffum, Director Agricultural Experiment Station	Laramie.

AMERICAN ASSOCIATION OF FARMERS' INSTITUTE WORKERS.

President, J. C. Hardy, president Mississippi Agricultural and Mechanical College, Agricultural College, Miss.; vice-president, E. A. Burnett, director Agricultural Experiment Station, Lincoln, Nebr.; secretary-treasurer, G. C. Creelman, president Ontario Agricultural College, Guelph, Ontario.

STATE OFFICIALS IN CHARGE OF AGRICULTURE.[a]

Commissioners of agriculture.

States and Territories.	Name of official.	Post-office.
Alabama	R. R. Poole	Montgomery.
Arkansas	H. T. Bradford	Little Rock.
Florida	B. E. McLin	Tallahassee.
Georgia	O. B. Stevens	Atlanta.
Idaho	Robert Bell	Boise.
Kentucky	Hubert Vreeland	Frankfort.
Louisiana	J. G. Lee	Baton Rouge.
Maine	A. W. Gilman	Augusta.
Montana	J. A. Ferguson	Helena.
New York	Chas. A. Wieting	Albany.
North Carolina	S. L. Patterson	Raleigh.
North Dakota	W. C. Gilbreath	Bismarck.
New Mexico	J. W. Raynolds, Secretary of State	Santa Fe.
Pennsylvania	N. B. Critchfield, Secretary of Agriculture	Harrisburg.
Philippine Islands	W. C. Welborn, Chief, Bur. of Agriculture	Manila.
Porto Rico	Wm. H. Elliott, Commissioner of the Interior	San Juan.
Tennessee	W. W. Ogilvie	Nashville.
Texas	W. J. Clay	Austin.
Virginia	Geo. W. Koiner	Richmond.
Washington	A. W. Frater, Deputy Secretary of State	Olympia.

Secretaries of State boards of agriculture.

States and Territories.	Name of official.	Post-office.
California	Harry Lowden, Acting Secretary	Sacramento.
Colorado	A. M. Hawley	Fort Collins.
Connecticut	J. F. Brown	North Stonington.
Delaware	Wesley Webb	Dover.
Hawaii	C. S. Holloway	Honolulu.
Illinois	W. C. Garrard	Springfield.
Indiana	Chas. Downing	Indianapolis.
Iowa	J. C. Simpson	Des Moines.
Kansas	F. D. Coburn	Topeka.
Maryland	Wm. T. P. Turpin, Supt. of Immigration	Centerville.
Massachusetts	J. L. Ellsworth	Boston.
Michigan	Addison M. Brown	Agricultural College.
Minnesota	E. W. Randall, Sec. State Ag'l Society	Hamline.
Missouri	George B. Ellis	Columbia.
Nebraska	Robt. W. Furnas	Brownville.
Nevada	Louis Bevier	Carson City.
New Hampshire	N. J. Bachelder	Concord.
New Jersey	Franklin Dye	Trenton.
North Carolina	T. K. Bruner	Raleigh.
Ohio	W. W. Miller	Columbus.
Oklahoma	J. B. Thoburn	Guthrie.
Oregon	M. D. Wisdom	Portland.
Rhode Island	John G. Clarke	Providence.
South Dakota	Walter B. Dean	Yankton.
Vermont	C. J. Bell	East Hardwick.
West Virginia	J. O. Thompson	Charleston.
Wisconsin	John M. True	Madison.
Wyoming	C. T. Johnston, State Engineer	Cheyenne.

[a] Officials of Territories and island dependencies are included. So far as learned, Arizona, Mississippi, New Mexico, South Carolina, and Utah have no State official charged with agricultural interests, but letters addressed to the Secretary of State would probably receive attention.

NATIONAL DAIRY ASSOCIATIONS.

Name of organization.	Secretary.	Post-office.
National Association of State Dairy and Food Departments.	R. M. Allen	Lexington, Ky.
National Dairy Union	Charles Y. Knight	154 Lake st., Chicago.
National Creamery Buttermakers' Association	E. Sudendorf	Clinton, Ill.
Boston Cooperative Milk Producers' Association	W. A. Hunter	10 Florence st., Worcester, Mass.
Five States Milk Producers' Association	H. T. Coon	Homer, N. Y.

NATIONAL LIVE STOCK ASSOCIATION.

President, F. J. Hagenbarth, Salt Lake City; secretary, Fred. B. Johnson, Denver.

AMERICAN ASSOCIATION OF LIVE STOCK HERD BOOK SECRETARIES.

President, C. R. Thomas, Independence, Mo.; secretary, Charles F. Mills, Springfield, Ill.

NATIONAL WOOL GROWERS' ASSOCIATION.

President, Francis E. Warren, Cheyenne; secretary, Mortimer Levering, Chicago, Ill.

PROTECTION AGAINST CONTAGION FROM FOREIGN CATTLE.

An act of Congress of August 28, 1894, prohibits the importation of cattle and cattle hides, but by the act of March 2, 1895, making appropriations for the Department of Agriculture, it is provided that the prohibition may be suspended by the President whenever the Secretary of Agriculture shall certify to the President what countries or parts of countries are free from contagious or infectious diseases of domestic animals. The President, by proclamation of November 8, 1895, lifted the embargo with reference to Norway, Sweden, Holland, Great Britain, Ireland, the Channel Islands, and the countries of North, Central, and South America so as to admit cattle under sanitary regulations prescribed by the Secretary of Agriculture; also from all countries so as to admit hides under regulations prescribed by the Secretary of the Treasury.

STOCK BREEDERS' ASSOCIATIONS.[a]

Names and addresses of stock association secretaries, with breeds and numbers of registered live stock in United States, December 31, 1904.

CATTLE.

Breed.	Secretary.	Post-office.	Number registered.		Number living.	
			Male.	Female.	Male.	Female.
Aberdeen Angus	Thos. McFarlane	Union Stock Yards, Chicago, Ill.	33,372	42,472	24,200	30,800
Ayrshire	C. M. Winslow	Brandon, Vt.	9,168	19,763	3,000	9,000
Devon	L. P. Sisson	Newark, Ohio	7,816	13,472	4,000	8,500
Dutch Belted	H. B. Richards	Easton, Pa	532	1,208	(b)	(b)
Galloway	C. W. Gray	Union Stock Yards, Chicago, Ill.	9,581	15,969	7,160	5,690
Guernsey	Wm. H. Caldwell	Peterboro, N. H	9,836	18,216	6,000	12,000
Hereford	C. R. Thomas	225 W. 12th st., Kansas City, Mo.	[c] 201,290		[c] 100,000	
Holstein Friesian	Frederick L. Houghton.	Brattleboro, Vt	88,180	42,682	(b)	(b)
Jersey	J. J. Hemingway	8 W. 17th st., New York, N. Y.	69,267	186,297	(b)	(b)
Polled Durham	Fletcher S. Hines	Indianapolis, Ind	4,878	5,885	2,926	3,528
Red Polled	J. McLain Smith	Dayton, Ohio	13,650	26,716	(b)	(b)
Shorthorn	John W. Groves	Union Stock Yards, Chicago, Ill.	231,405	366,425	77,100	165,000
Sussex	Overton Lea	Nashville, Tenn	70	172	40	85
Swiss, Brown	N. S. Fish	Groton, Conn	2,007	2,879	1,338	1,919

[a] Under the provisions of paragraph 473 of the act of July 24, 1897, amended March 3, 1903, any animal imported specially for breeding purposes shall be admitted free, provided that no such animal shall be admitted free unless pure bred, of a recognized breed, and duly registered in the book of record established for that breed. The Secretary of the Treasury, upon the advice of the Secretary of Agriculture, issued April 24, 1903, regulations for the importation of animals under this law, and designated the recognized breeds and the books of record established for these breeds.

[b] No data.

[c] Total of males and females.

Names and addresses of stock association secretaries, with breeds and numbers of registered live stock in United States, December 31, 1904—Continued.

HORSES.

Breed.	Secretary.	Post-office.	Number registered. Male.	Number registered. Female.	Number living. Male.	Number living. Female.
Cleveland Bay	R. P. Stericker	80 Chestnut ave., W. Orange, N. J.	1,205	470	1,000	400
Clydesdale	R. B. Ogilvie	Union Stock Yards, Chicago, Ill.	[b]11,000		(a)	(a)
Coach, German	J. Crouch	Lafayette, Ind	1,126	141	[b]1,000	
Coach, German (Oldenburg).	C. E. Stubbs	Fairfield, Iowa	[c]217	[c]27	(a)	(a)
Draft, Belgian	J. D. Connor, jr	Wabash, Ind	1,787	227	1,786	227
Draft, French	C. E. Stubbs	Fairfield, Iowa	8,393	4,557	[b]5,000	
Hackney	A. H. Godfrey	Box 111, Madison Square, New York City.	726	1,542	684	1,416
Morgan	Joseph Battell[d]	Middlebury, Vt	[e]5,021	2,800	3,765	2,100
Percheron	Geo. W. Stubblefield.	Union Stock Yards, Chicago, Ill.	540	460	18,540	11,460
Percheron	Charles C. Glenn	Columbus, Ohio	295	17	290	13
Saddle Horse, American.	I. B. Nall	Louisville, Ky	[e]2,359	3,247	1,200	1,500
Shetland Pony	Mortimer Levering.	Lafayette, Ind	1,777	3,555	1,600	2,500
Shire	Charles Burgess	Wenona, Ill	5,663	2,007	(a)	(a)
Suffolk	Alex. Galbraith	Janesville, Wis	147	66	100	50
Thoroughbred	James E. Wheeler[d]	173 Fifth ave., New York, N. Y.	[b]42,000		[b]25,000	
Trotter, American	Wm. H. Knight	Ellsworth Bldg., 355 Dearborn st., Chicago, Ill.	[e]40,200	[c]104,300	26,800	69,533
Jacks and Jennies	J. W. Jones	Columbia, Tenn	800	600	(a)	(a)

SHEEP.

Breed.	Secretary.	Post-office.	Number registered. Male.	Number registered. Female.	Number living. Male.	Number living. Female.
Cheviot	F. E. Dawley	Fayetteville, N. Y	[b]10,332		[b]3,000	
Cotswold	F. W. Harding	Waukesha, Wis	[b]32,705		[b]12,000	
Dorset Horn	J. E. Wing	Mechanicsburg, Ohio.	1,134	3,100	850	2,325
Dorset Horn	M. A. Cooper	Washington, Pa	[b]10,550		[b]5,000	
Hampshire Down	Comfort A. Tyler	Nottawa, Mich	4,900	11,501	(a)	(a)
Leicester	A. J. Temple	Cameron, Ill	3,135	4,944	2,633	4,153
Lincoln	Bert Smith	Charlotte, Mich	5,500	7,140	4,000	5,000
Merino (Delaine)	H. G. McDowell	Canton, Ohio	[b]9,000		[b]7,000	
Merino (Delaine)	George A. Henry	R. F. D. 8, Bellefontaine, Ohio.	8,000	12,000	3,000	7,000
Merino (Delaine)	J. B. Johnson	248 W. Pike st., Canonsburg, Pa.	6,674	11,324	1,500	5,000
Merino (Delaine)	S. M. Cleaver	W. Brownsville, Pa.	(a)	(a)	[c]9,000	[c]13,000
Merino (French)	Dwight Lincoln	Milford Center, Ohio.	[b]27,834		[c]8,000	[c]12,000
Merino (German)	E. M. Moore	Orchard Lake, Mich.	112	140	50	130
Merino (Spanish)	E. N. Ball	Hamburg, Mich	13,750	41,250	1,000	9,000
Merino (Spanish)	R. O. Logan	R. F. D. 3, Montgomery, Mich.	[b]28,374		[c]1,000	[c]2,000
Merino (Spanish)	J. H. Earll	Skaneateles, N. Y	[b]19,625		[b]2,100	
Merino (Spanish)	J. P. Ray	Allenshill, N. Y	(a)	(a)	50	150
Merino (Spanish)	C. A. Chapman	Middlebury, Vt	[b]219,066		(a)	(a)
Oxford Down	W. A. Shafor	Hamilton, Ohio	[b]32,798		(a)	(a)
Shropshire	Mortimer Levering.	Lafayette, Ind	50,000	158,000	15,000	45,000
Southdown	Frank S. Springer.	Springfield, Ill	[b]18,690		[b]9,345	
Suffolk	George W. Franklin.	Des Moines, Iowa	[b]905		[b]500	

[a] No data.
[b] Total of males and females.
[c] Estimate for 1903.
[d] Registrar.
[e] Includes geldings.

Names and addresses of stock association secretaries, with breeds and numbers of registered live stock in United States, December 31, 1904—Continued.

HOGS.

Breed.	Secretary.	Post-office.	Number registered.		Number living.	
			Male.	Female.	Male.	Female.
Berkshire	Frank S. Springer	510 Monroe st., Springfield, Ill.	[a] 80,920		[a] 30,000	
Cheshire	Ed S. Hill	Freeville, N. Y	1,200	2,088	300	600
Chester White	Ernest Freigau	Dayton, Ohio	[a] 11,911		[b] 489	[b] 1,307
Chester White	W. H. Morris	939 S. Illinois St., Indianapolis, Ind.	[c] 6,002	[c] 13,629	([d])	([d])
Chester Ohio Improved.	C. M. Hiles	40 Sherriff St., Cleveland, Ohio.	[a] 9,688		[a] 5,800	
Duroc Jersey	T. B. Pearson	Thorntown, Ind	7,074	16,310	([d])	([d])
Duroc Jersey	Robert J. Evans	Elpaso, Ill	16,750	41,000	4,187	10,250
Essex	F. M. Srout	McLean, Ill	1,216	1,800	500	800
Hampshire (Thin Rind).	E. C. Stone	Armstrong, Ill	218	454	95	310
Poland China	W. M. McFadden	Union Stock Yards, Chicago, Ill.	46,407	116,484	20,000	50,000
Poland China	W. H. Morris	939 S. Illinois st., Indianapolis, Ind.	[e] 12,025	[e] 26,659	([d])	([d])
Poland China	A. M. Brown	Dayton, Ohio	31,250	70,000	9,000	21,000
Poland China	Geo. F. Woodworth	Maryville, Mo	35,838	85,052	5,364	12,677
Poland China	H. P. Wilson	Gadsden, Tenn	609	904	500	650
Tamworth	E. N. Ball	Hamburg, Mich	[a] 1,949		[a] 1,200	
Victoria	H. Davis	Dyer, Ind	[b] 437	[b] 1,326	[a b] 1,200	
Yorkshire Large Improved.	Harry G. Krum	Whitebear Lake, Minn.	2,457	3,079	2,000	2,600

[a] Total of males and females.
[b] Estimate for 1903.
[c] Vol. IX, 1902.
[d] No data.
[e] Vol. XXIV, 1903.

SANITARY OFFICERS IN CHARGE OF LIVE STOCK INTERESTS.

States and Territories.	Name and post-office.	Official position.
Alabama	C. A. Cary, Auburn	Professor of veterinary science.
Arizona	J. D. Carter, Prescott	Secretary live stock sanitary commission.
	J. C. Norton, Phoenix	Veterinarian.
Arkansas	R. R. Dinwiddie, Fayetteville	State veterinarian.
California	Chas. Keane, Sacramento	Do.
Colorado	L. B. Sylvester, Denver	President State board of stock inspection.
	Charles D. Lamb, Denver	State veterinary surgeon.
Connecticut	Heman O. Averill, Hartford	Commissioner of domestic animals.
Delaware	Alex. Lowber, Wilmington	Secretary State board of health.
	H. P. Eves, Newark	Instructor in veterinary science, Delaware College.
Florida	Chas. F. Dawson, Lake City	State veterinarian.
Georgia	O. B. Stevens, Atlanta	Commissioner of agriculture.
Idaho	George E. Noble, Boise	State veterinarian.
Illinois	H. E. Wadsworth, Springfield	Secretary board of live stock commissioners.
	C. P. Lovejoy, Princeton	State veterinarian.
Indiana	A. W. Bitting, Lafayette	Do.
Iowa	Paul O. Koto, Forest City	Do.
Kansas	John D. Baker, Peabody	Secretary live stock sanitary commission.
Kentucky	J. N. McCormack, Bowling Green	Secretary State board of health.
	F. T. Eisenman, Louisville	State veterinarian.
Louisiana	W. H. Dalrymple, Baton Rouge	Veterinarian State experiment station.
Maine	F. O. Beal, Bangor	State cattle commissioner.
Maryland	G. Allen Jarman, Chestertown	Chief veterinary inspector.
	Wade H. D. Warfield, Baltimore	Secretary live stock sanitary board.
Massachusetts	Austin Peters, Boston	Chief of the cattle bureau of State board of agriculture.
Michigan	F. C. Wells, Saline	State veterinarian.
	H. H. Hinds, Stanton	President State live stock sanitary commission.
Minnesota	M. H. Reynolds, St. Anthony Park	Veterinarian live stock sanitary board.
	H. M. Bracken, St. Paul	Secretary State board of health.
Mississippi	J. C. Robert, Agricultural College	Professor of veterinary science.
Missouri	D. F. Luckey, Columbia	State veterinarian.
	Geo. B. Ellis, Columbia	Secretary State board of agriculture.
Montana	W. G. Preuitt, Helena	Secretary live stock commission.
	M. E. Knowles, Helena	State veterinarian.
Nebraska	W. A. Thomas, Lincoln	Do.
Nevada	S. L. Lee, Carson City	Secretary State board of health.

Sanitary officers in charge of live stock interests—Continued.

States and Territories.	Name and post-office.	Official position.
New Hampshire	Irving A. Watson, Concord	Secretary State board of health.
	N. J. Bachelder, Concord	Secretary board of cattle commissioners.
New Jersey	Henry Mitchell, Trenton	Secretary State board of health.
	Franklin Dye, Trenton	Secretary tuberculosis commission.
New Mexico	W. C. Barnes, Las Vegas	Secretary cattle sanitary board.
	Harry F. Lee, Albuquerque	Secretary sheep sanitary board.
New York	C. A. Wieting, Cobleskill	Commissioner department of agriculture.
	W. H. Kelly, Albany	Chief veterinarian.
North Carolina	Tait Butler, Raleigh	State veterinarian.
	S. L. Patterson, Raleigh	Commissioner of agriculture.
North Dakota	L. Van Es, Fargo	Chief State veterinarian.
Ohio	W. W. Miller, Columbus	Secretary State board of agriculture.
	Paul Fischer, Columbus	State veterinarian.
Oklahoma	Thomas Morris, Guthrie	Secretary live stock sanitary commission.
	L. D. Brown, Guthrie	Territorial veterinarian.
Oregon	Wm. McLean, Portland	State veterinarian.
Pennsylvania	Leonard Pearson, Philadelphia	Do.
Rhode Island	John G. Clarke, Providence	Secretary State board of agriculture.
	John S. Pollard, Providence	Veterinarian, State board of agriculture.
South Carolina	Louis A. Klein, Clemson College	State veterinarian.
South Dakota	J. P. Foster, Huron	Do.
Tennessee	R. H. Kittrell, Murfreesboro	State live stock commissioner.
Texas	M. M. Hankins, Quanah	Live stock sanitary commissioner.
Utah	T. B. Beatty, Salt Lake City	Secretary State board of health.
Vermont	Victor I. Spear, Randolph	Secretary cattle commission
Virginia	J. G. Ferneyhough, Blacksburg	State veterinarian.
Washington	S. B. Nelson, Pullman	Do.
West Virginia	J. O. Thompson, Charleston	Secretary board of agriculture.
Wisconsin	Evan D. Roberts, Janesville	State veterinarian.
	George Wylie, Morrisonville	Secretary State sanitary board.
Wyoming	Geo. T. Seabury, Cheyenne	State veterinarian.
	George S. Walker, Cheyenne	Secretary State board of sheep commissioners.

OFFICIALS IN CHARGE OF FOOD INSPECTION.

Name of office.	Official.	Post-office.
Commissioner of Internal Revenue, Treasury Department.	John W. Yerkes	Washington, D. C.
Chief, Bureau of Animal Industry, Department of Agriculture.	D. E. Salmon	Do.
Chief, Bureau of Chemistry, Department of Agriculture.	H. W. Wiley	Do.

FORESTRY ASSOCIATIONS.

American Forestry Association.—President, Hon. James Wilson, Secretary of Agriculture; vice-president, James W. Pinchot; secretary (corresponding), H. M. Suter, Washington, D. C.

International Society of Arboriculture.—President, Gen. William J. Palmer, Colorado Springs, Colo.; vice-president, Henry John Elwes, F. R. S., Colesborne, Cheltenham, England; secretary, J. P. Brown, Connersville, Ind.

Society of American Foresters.—President, Gifford Pinchot, Washington, D. C.; secretary, George B. Sudworth, Washington, D. C.

SCHOOLS OF FORESTRY.

Yale Forest School, Yale University, New Haven, Conn.—A two-year graduate course, leading to the degree of Master of Forestry. The junior year begins in July, the first term being conducted at Milford, Pike County, Pa. Under the direction of the officers of the Yale Forest School a two-month popular course, July and August, also is conducted at Milford, Pike County, Pa. Prof. Henry S. Graves, Director.

Biltmore Forest School, Biltmore, N. C.—An undergraduate course, covering one year, without vacation. Dr. C. A. Schenck, Director.

University of Michigan Forest School, part of the general Department of Literature, Science, and the Arts, Ann Arbor, Mich.—A two-year graduate course, leading to the degree of Master of Science in Forestry. Filibert Roth, Professor of Forestry.

Harvard University Forest School, Cambridge, Mass.—A four-year undergraduate course, in connection with the Lawrence Scientific School. R. T. Fisher, in charge of curriculum.

Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa.—A four-year course in forestry and horticulture, in which particular attention is paid to farm forestry, leading to the degree of Bachelor of Science. A course is also given adapted to students in the civil engineering department. H. P. Baker, Assistant Professor, in charge of forestry.

University of Maine, Department of Forestry, Orono, Me.—A four-year undergraduate course, leading to the degree of Bachelor of Science in Forestry. Prof. S. N. Spring, in charge of department.

Michigan Agricultural College, Department of Forestry, Agricultural College, Mich.—A four-year undergraduate course, leading to the degree of Bachelor of Science. E. E. Bogue, Professor of Forestry.

University of Minnesota, Forest School, St. Anthony Park, Minn.—A four-year undergraduate course, leading to the degree of Bachelor of Science in Forestry. Prof. Samuel B. Green, in charge of school.

University of Nebraska, Forest Department, connected with the Industrial College, Lincoln, Nebr.—A four-year undergraduate course, leading to the degree of Bachelor of Science in Forestry. Frank G. Miller, Professor of Forestry.

NATIONAL GOOD ROADS ASSOCIATION.

President, W. H. Moore; secretary, R. W. Richardson; treasurer, C. H. Huttig. General office, Laclede Building, St. Louis, Mo.

NATIONAL BEE KEEPERS' ASSOCIATION.

President, J. U. Harris, Grand Junction, Colo.; secretary, W. Z. Hutchinson, Flint, Mich.; general manager and treasurer, N. E. France, Platteville, Wis.

NATIONAL ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

President, H. Garman, Lexington, Ky.; secretary, H. E. Summers, Ames, Iowa.

ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS.

President, C. L. Penny, Agricultural Experiment Station, Newark, Del.; secretary, H. W. Wiley, Chemist, Department of Agriculture, Washington, D. C.

NATIONAL HORTICULTURAL AND KINDRED SOCIETIES.

Name of organization.	Secretary.	Post-office.
American Apple Growers' Congress	T. C. Wilson	Hannibal, Mo.
American Association of Nurserymen	George C. Seager	Rochester, N. Y.
American Carnation Society	Albert M. Herr	Lancaster, Pa.
American Cranberry Growers' Association	A. J. Rider	Hammonton, N. J.
American Institute Farmers' Club	W. Eagleson	19-21 West 44th street, New York, N. Y.
American Institute Horticultural Society	Leonard Barron	Do.
American Nurserymen's Protective Association	Thomas B. Meehan	Dreshertown, Pa.
American Pomological Society	John Craig	Ithaca, N. Y.
American Retail Nurserymen's Protective Association	Guy A. Bryant	Princeton, Ill.
American Rose Society	W. J. Stewart	11 Hamilton place, Boston, Mass.
Cider and Cider-Vinegar Makers' Association of the Northwest	George Miltenberger	213 N. 2d street, St. Louis, Mo.
Chrysanthemum Society of America	Fred H. Lemon	Richmond, Ind.
Eastern Nurserymen's Association	Wm. Pitkin	Rochester, N. Y.
International Apple Shippers' Association	A. Warren Patch	17 N. Market street, Boston, Mass.
Mississippi Valley Apple Growers' Association	James Handly	Quincy, Ill.
Missouri Valley Horticultural Society	Mrs. H. E. Chandler	R. F. D., No. 2, Argentine, Kans.
National Federation of Horticultural Societies	C. E. Bassett	Fennville, Mich.
National League of Commission Merchants of the United States	A. Warren Patch	17 N. Market street, Boston, Mass.
National Nut Growers' Association	James F. Wilson	Poulan, Ga.
Northwestern Fruit Growers' Association	M. Hoffman	Lagrande, Oreg.
Nurserymen's Mutual Protection Association	Geo. C. Seager	Rochester, N. Y.
Peninsula Horticultural Society	Wesley Webb	Dover, Del.
Society of American Florists	Wm. J. Stewart	11 Hamilton place, Boston, Mass.
Southwestern Nurserymen's Association	J. A. Taylor	Wynnewood, Ind. T.
Western Association of Wholesale Nurserymen	E. J. Holman	Leavenworth, Kans.

ORGANIZATIONS FOR PROTECTION OF BIRDS AND GAME.

Name of organization.	Secretary.	Post-office.
American Ornithologists' Union, Committee on Protection of North American Birds.	William Dutcher, chairman.	525 Manhattan avenue, New York, N. Y.
Bird Protective Society of America	Edward C. Pease	28 Stafford Building, Buffalo, N. Y.
Boone and Crockett Club	Madison Grant	11 Wall street, New York, N. Y.
League of American Sportsmen	Arthur F. Rice	155 Pennington avenue, Passaic, N. J.
National Association of Audubon Societies	William Dutcher, president.	525 Manhattan avenue, New York, N. Y.
National Association of Game and Fish Wardens.	Charles E. Brewster	Grand Rapids, Mich.
National Game, Bird, and Fish Protective Association.	do	Do.
New York Zoological Society	Madison Grant	11 Wall street, New York, N. Y.
North American Fish and Game Protective Association.	E. T. D. Chambers	Quebec, Canada.

FARMERS' NATIONAL CONGRESS.

President, Harvie Jordan, Monticello, Ga.; first vice-president, B. Cameron, Stagville, N. C.; second vice-president, Joshua Strange, Marion, Ind.; treasurer, A. H. Judy, Greenville, Ohio; secretary, John M. Stahl, 4328 Langley avenue, Chicago, Ill.; first assistant secretary, George M. Whittaker, Boston, Mass.; second assistant secretary, A. C. Fuller, Dows, Iowa; third assistant secretary, Luther H. Tucker, Albany, N. Y.; executive committee, W. M. Ames, Oregon, Wis.; E. W. Wickey, Ocean Springs, Miss.; Levi Morrison, Greenville, Pa.

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REVIEW OF WEATHER AND CROP CONDITIONS, SEASON OF 1904.

By JAMES BERRY, *Chief, Climate and Crop Division, Weather Bureau.*

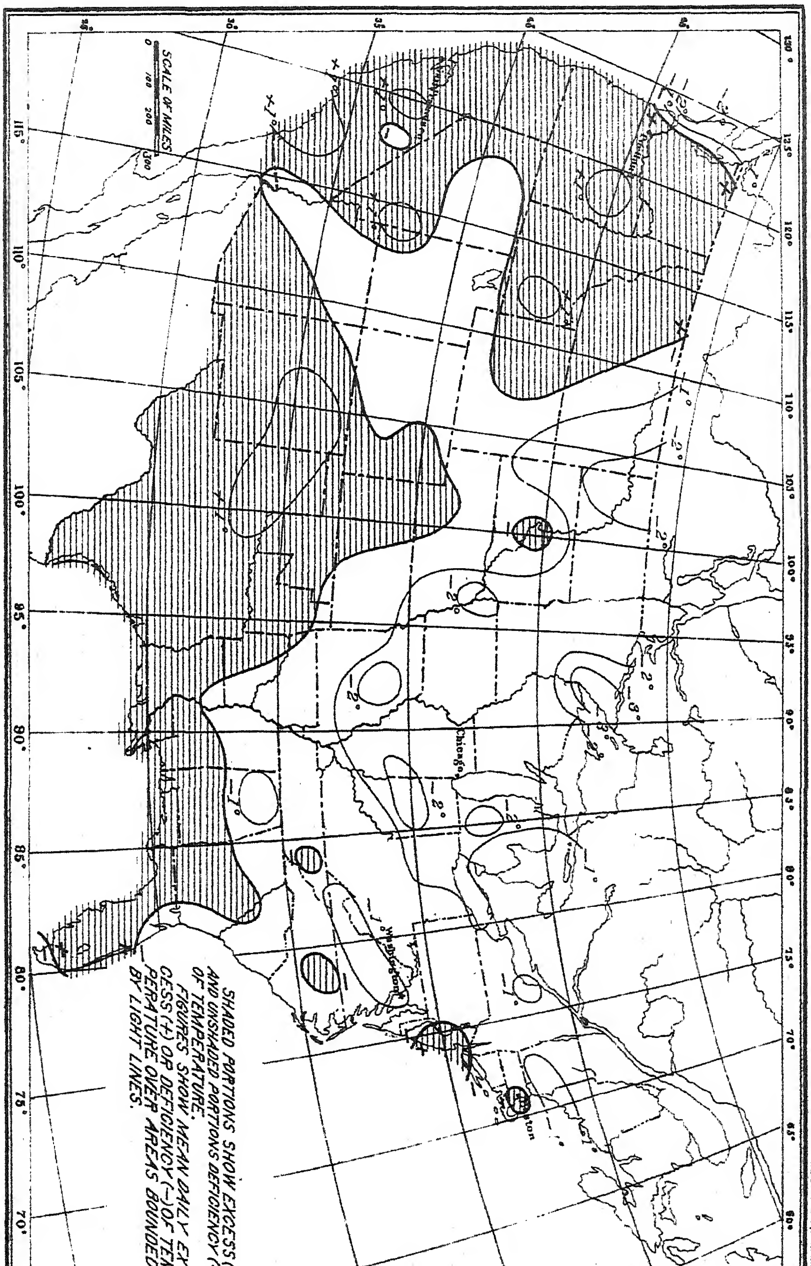
The accompanying illustrations (see figures 61-63 and plates LXXII-LXXIV) and tables (pages 577 to 580) show how the temperature and rainfall over the United States during the crop season of 1904, from week to week, compare with normal conditions of corresponding periods of former years. The diagrams exhibit the departures from normal, by districts, and the maps show, respectively, the departures from normal temperature, the total precipitation, and the departures from normal precipitation during the crop season.

JANUARY.

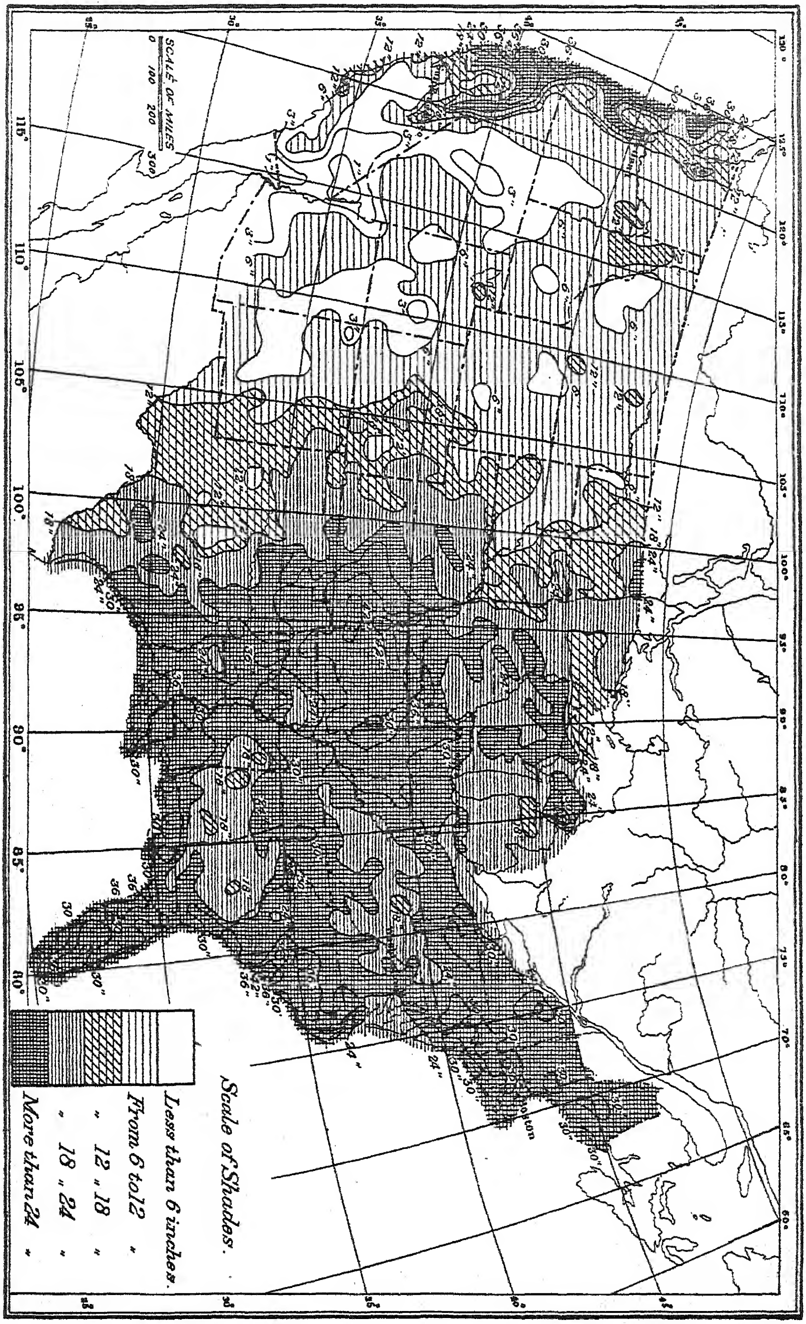
January, 1904, was colder than usual in the districts east of the Mississippi River, the deficiency in temperature having been very marked in the Lake region, New England, and Middle Atlantic States, where it ranged from 6° to 9° per day. West of the Mississippi River the month was generally milder than usual. In portions of California and western Nevada the temperature excess amounted to more than 3° per day, and from eastern Washington to the western portions of the Dakotas and Nebraska it ranged from 6° to more than 12°, being greatest in Montana. Along the central and northern California coasts and in the west Gulf States the average temperature differed but slightly from the normal.

SHORTAGE OF PRECIPITATION.

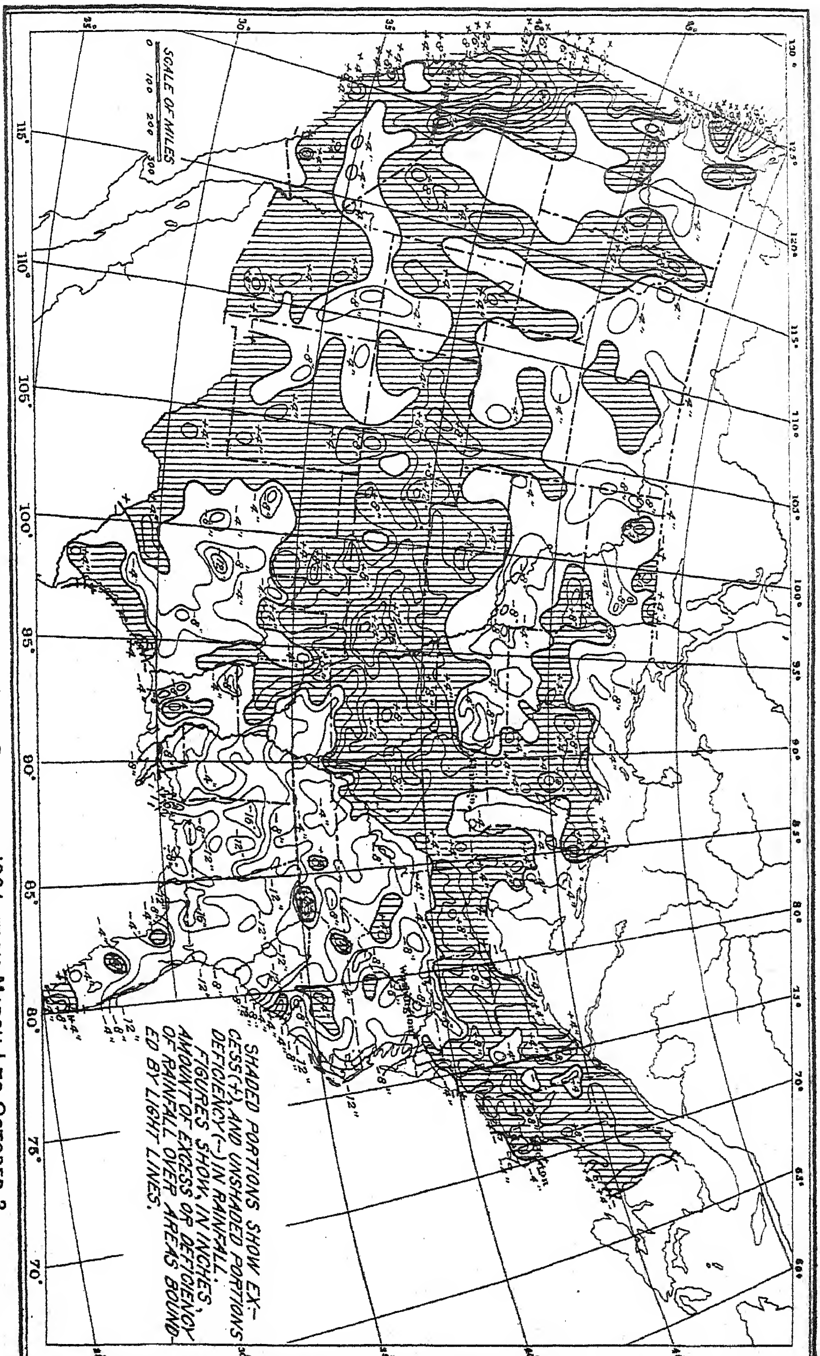
As a whole the precipitation was below the normal. Over a comparatively narrow area extending from Oklahoma northeastward to southern New England, and in



DEPARTURES FROM NORMAL TEMPERATURE FOR THE CROP SEASON OF 1904, FROM MARCH 1 TO OCTOBER 3.



TOTAL PRECIPITATION FOR THE CROP SEASON OF 1904, FROM MARCH 1 TO OCTOBER 3.



DEPARTURES FROM NORMAL PRECIPITATION FOR THE CROP SEASON OF 1904, FROM MARCH 1 TO OCTOBER 3.

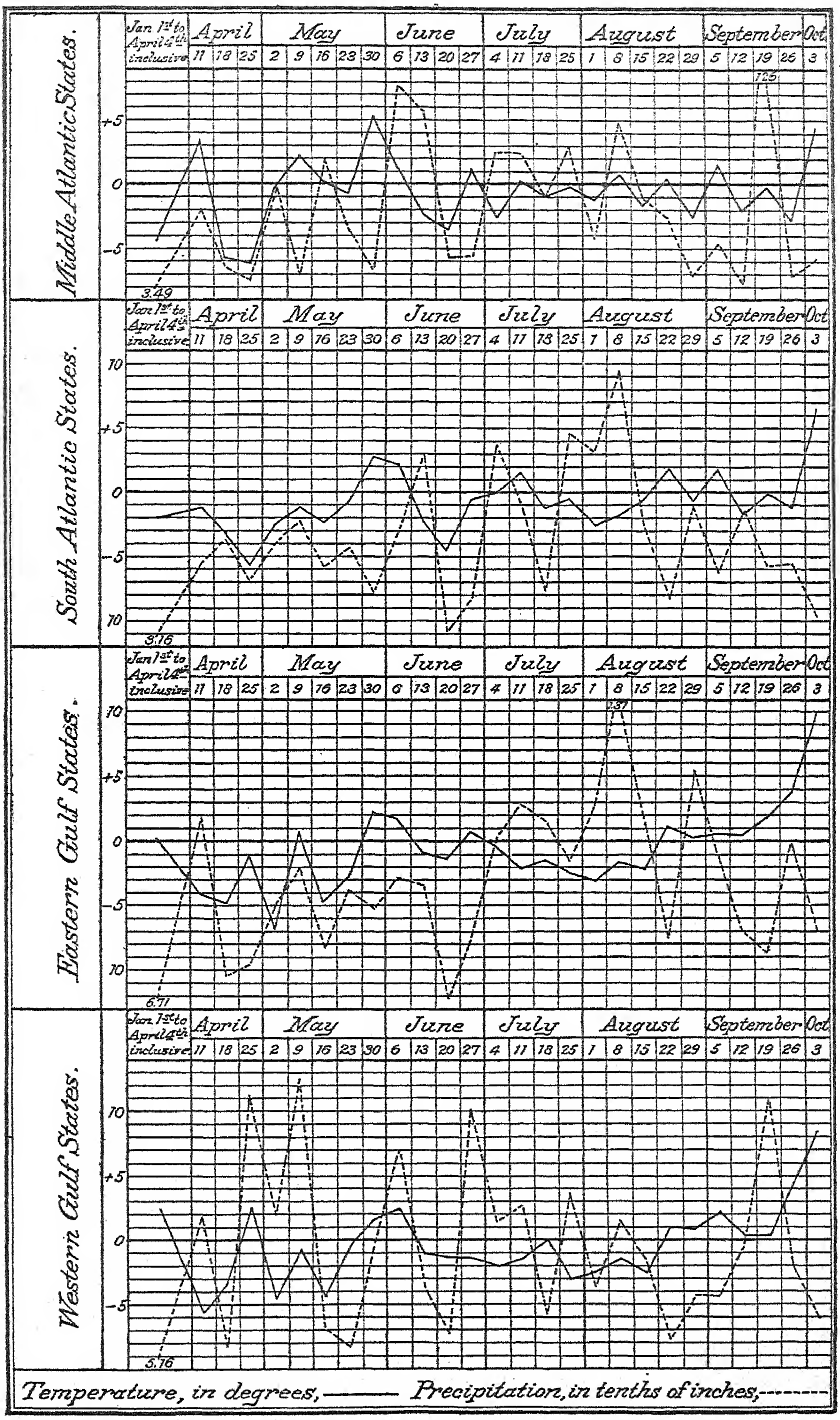


FIG. 61.—Temperature (degrees Fahrenheit) and precipitation (inches) departures for the season of 1904 from the normal of many years for the Middle and South Atlantic States, and Gulf States.

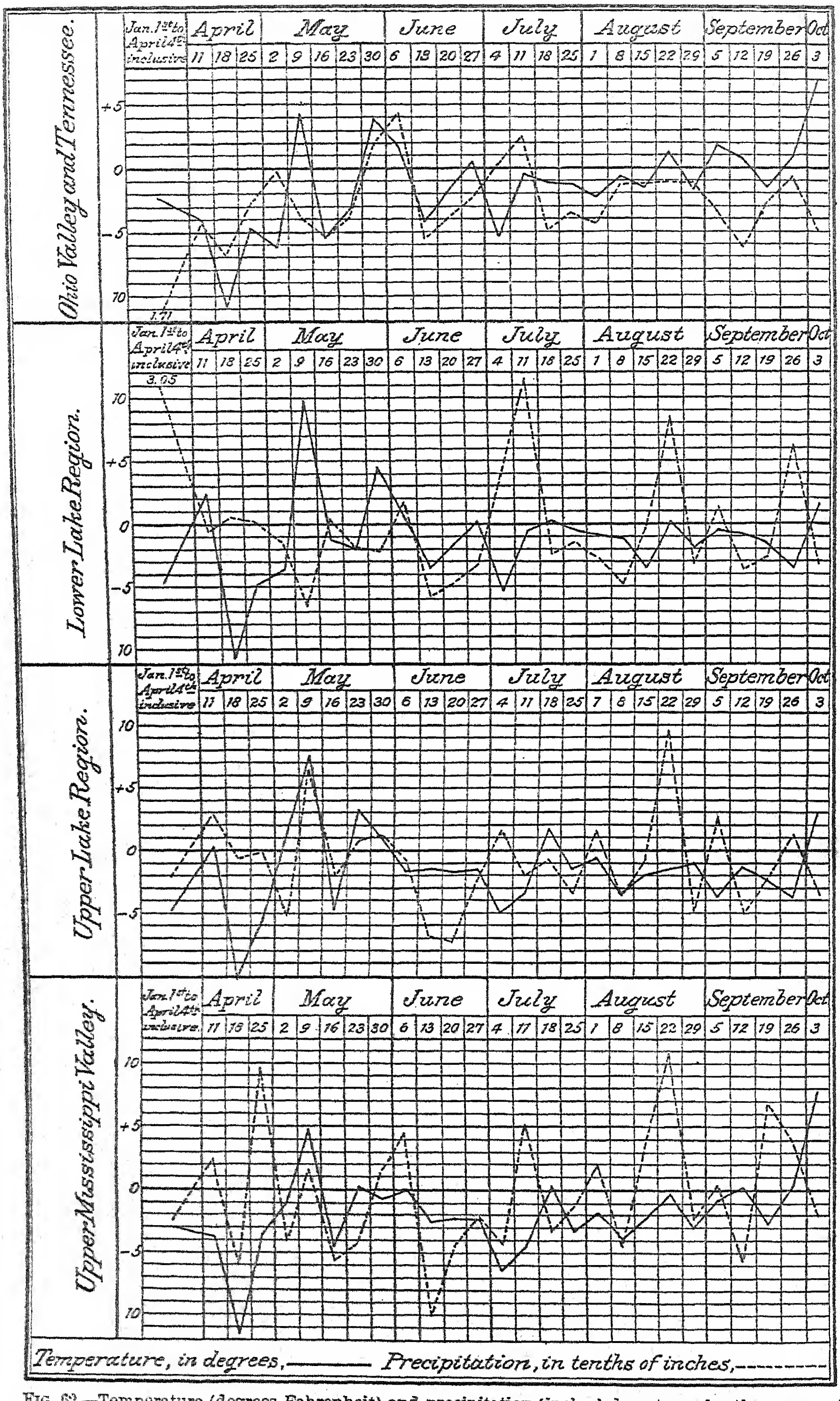


FIG. 62.—Temperature (degrees Fahrenheit) and precipitation (inches) departures for the season of 1904 from the normal of many years for the Lake Region, the Upper Mississippi Valley, the Ohio Valley, and Tennessee.

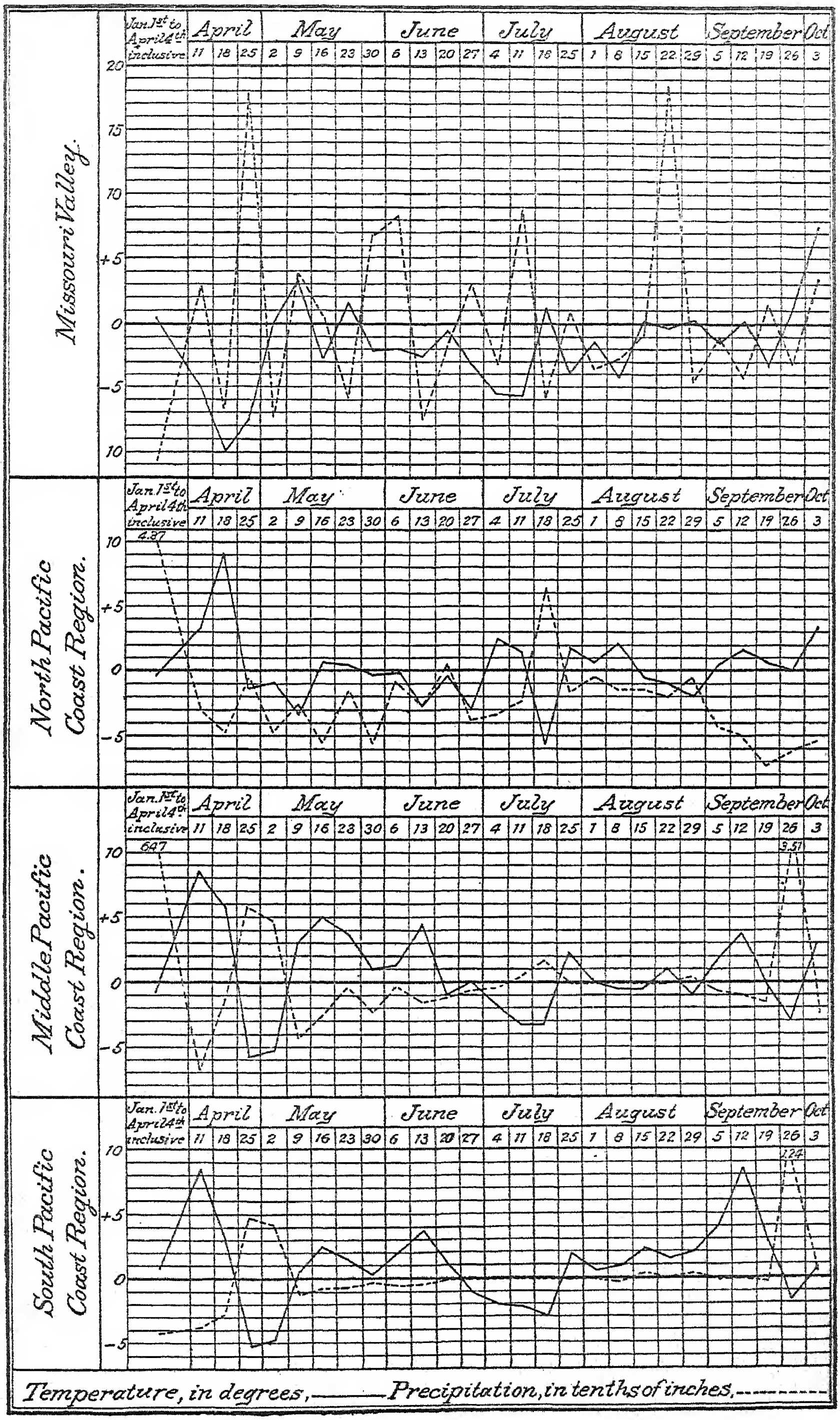


FIG. 63.—Temperature (degrees Fahrenheit) and precipitation (inches) departures for the season of 1904 from the normal of many years for the Missouri Valley and the Pacific coast.

central and northern Florida, southeastern Georgia, and a few other limited areas, it exceeded the average, quite a decided excess occurring in portions of southern New England, the lower Lake region, Ohio Valley, northwestern Arkansas and adjacent portions of Indian Territory, and in northern Florida; but over much the greater part of the country the precipitation was below the average, a marked deficiency occurring over the greater part of the Gulf and Atlantic coast districts, and also in the upper Lake region and on the Pacific coast.

SNOW AND WINTER WHEAT.

At the close of the month the northern Rocky Mountain districts and all northern and central districts eastward of the Missouri Valley were covered with snow, the southern limit extending to the northern portions of the central and east Gulf States, while depths ranging from 1 to 3 feet existed in the northern portion of the Lake region and northern New England.

Over the southern portions of the winter-wheat belt winter wheat was largely without snow protection until near the close of the month, when the northern, central, and eastern portions were well covered. In the Middle Atlantic States and portions of the Ohio and central Mississippi valleys the crop suffered as a result of the protracted cold and absence of snow covering during a large part of the month.

FEBRUARY.

February was very mild from central Texas northwestward to Idaho and the eastern portions of Oregon and Washington, and the temperature averaged above normal throughout the Plateau region, the greater part of California, and the west Gulf States. The average daily excess over most of the districts named was more than 3°, and from central Texas northwestward to southern Idaho and eastern Oregon it generally ranged from 6° to 10°. Along the immediate Pacific coast a number of stations showed slight deficiencies, but in the interior portions of the Pacific coast States the month averaged milder than usual. In the South Atlantic and east Gulf States, and from the New England and middle Atlantic coasts westward to the Missouri Valley, including northeastern Montana, the month averaged colder than usual, being decidedly cold in the central valleys, Lake region, Middle Atlantic States, and New England, where the temperature deficiency ranged from 6° to 12°, being most marked in the Lake region and northern New England.

SNOW AND RAINFALL.

The precipitation was unusually heavy in the middle and north Pacific coast districts, where the total for the month generally ranged from 5 to 16 inches, or from 2 to 9 inches more than the February average. In the southern Plateau region and over much of the greater part of the country east of the Rocky Mountains the precipitation was lighter than usual; only comparatively small areas, confined principally to the South Atlantic and east Gulf States, received more than the monthly average. Throughout the central valleys and over the greater part of the Lake region, the Middle Atlantic States, and New England the deficiency ranged from 1 to more than 4 inches. With the exception of areas of limited extent, there was also a marked deficiency in the central and west Gulf States and in Florida.

At the close of the month the extreme northern districts were covered with snow from the New England coast almost to the north Pacific coast, but the southern limit did not extend below the southern portions of the Lake region. From the northern Rocky Mountain region to the New England coast the depths generally ranged from 3 inches to more than 2 feet, being greatest over the upper Lake region and northern New England.

FARM WORK IN SOUTH—CONDITION OF WHEAT.

In the central and west Gulf States the general conditions were favorable for such farm work as is usually carried on at this season. In these districts work was unusually well advanced; corn planting had begun generally throughout Texas, while extensive preparations for corn and cotton planting had been made throughout the Gulf States, but more especially in the central and western portions. Some spring seeding had been done in Kansas, Oklahoma, and Colorado.

As a whole the reports regarding winter wheat indicated that the condition of the crop was unpromising over much the greater part of the winter-wheat belt, the most unfavorable reports having been received from the middle and eastern districts. At

the beginning of the month the greater part of the winter-wheat area was well covered with snow, but only the more northerly portions were protected during the greater part of the month.

MARCH.

The month was colder than usual in the extreme northern districts from Lake Superior westward to the north Pacific coast, including the western portion of the central Plateau region and the middle Pacific coast districts. The average daily temperature deficiency ranged from 3° to 4° per day from northern California northward to the Puget Sound region, and was much more decided over the northern portions of Montana and northwestern North Dakota, where it ranged from 3° to 14°. The weather was slightly cooler than usual on the north Atlantic coast northward of the Delaware Bay, the deficiencies ranging from 1° to 2° per day. Elsewhere, and over much the greater part of the country, it was milder than usual. Throughout the Middle Atlantic States, Lake region, Ohio and upper Mississippi valleys, and the northern portion of the east Gulf States, the temperature excess was very slight, ranging from 1° to 2° per day; but over the southeastern Rocky Mountain slope, the west Gulf States, and portions of Virginia, North Carolina, eastern Tennessee, and the upper Ohio Valley, it was more marked, and ranged from 3° to 8°, the greatest departure occurring in Texas, Oklahoma, and western Kansas.

MUCH SNOW AND RAIN EXCEPT ON THE ATLANTIC AND THE GULF COASTS.

Excessively heavy precipitation occurred in the Pacific coast and northern Rocky Mountain districts and in the central valleys and over the greater part of the Lake region. On the Pacific coast northward of San Francisco the total monthly precipitation ranged from 6 to 19 inches, being greatest on the northern California coast, and in the central valleys from 6 to 11 inches, the Ohio and central Mississippi valleys receiving the greatest amount. In the Atlantic coast and Gulf districts, and over the middle and southern Rocky Mountain slope and the southern Plateau region, the month was drier than usual. A considerable area, embracing western Texas and portions of Kansas and New Mexico, received no appreciable amount, while the deficiency over a large part of the Gulf and Atlantic coast districts ranged from 1 to 4 inches.

At the close of the month the country east of the Rocky Mountains was practically free from snow, excepting portions of the Adirondack region and the upper Michigan peninsula.

SEASON BACKWARD IN NORTHERN DISTRICTS—FLOODS IN NORTHERN CALIFORNIA.

From the upper Mississippi Valley to the middle Atlantic coast the season was generally reported backward, although the average temperature for the month in these districts was generally in excess of the normal. In the Southern States the month was mild and favorable for farming operations. The northern portion of the central Gulf States, however, as well as the central valleys and the greater part of the Lake region, suffered from excessive rains, and western Texas and the southern Plateau region from drought. From northern Wisconsin westward to the Rocky Mountains the ground was still frozen deeply and no farm work had been done. On the Pacific coast the month was cold and wet, wholly preventing farm work in Washington and Oregon. The highest water known in many years, flooding thousands of acres of valuable grain lands, occurred in northern California during the first and second decades of the month.

Over the western portion of the principal winter-wheat area the reports indicated an improvement in the condition of winter wheat, and in some of the more easterly sections a slight improvement was also indicated. As at the close of the previous month, the least favorable reports were received from the central and eastern districts. In Indiana the crop was badly washed on high lands and much injured by floods on low lands, but where not thus damaged it was healthy and growing. In the western portions of the wheat area in Nebraska and Kansas the crop had suffered from drought.

In the Gulf States much corn had been planted and good stands were reported. Some planting had been done in the southern portions of Kansas and Missouri. Preparations for corn planting in the central Mississippi and Ohio valleys and Middle Atlantic States progressed slowly.

In the central and western portions of the cotton belt cotton planting was progressing rapidly at the close of the month, and some planting had been done in all the eastern districts. In southern Texas about half the crop had been planted, and the early planted was coming up nicely.

THE CROP SEASON, APRIL–SEPTEMBER, SUMMARY BY WEEKS.

By weeks, ending with Monday, from April 11 to October 3, the crop conditions may be summarized as follows:

April 11.—As a whole, the weather conditions were not favorable for farming operations in the principal agricultural districts east of the Rocky Mountains, having been unseasonably cold in the central valleys and Southern States, with too much moisture over the Middle Gulf States and a large part of the central valleys. More favorable conditions prevailed in the Middle and South Atlantic States and Rocky Mountain region. Temperatures below freezing occurred as far south as the interior of the South Atlantic States on the 4th and 5th, with more or less damaging effects. In the northern and central districts east of the Rocky Mountains the season was from one to two weeks later than usual, and was also backward on the North Pacific coast.

OUTLOOK FOR CORN, WHEAT, AND COTTON.

East of the Mississippi River no corn had been planted northward of Tennessee and North Carolina, but a large part of the crop had been planted in the last-named State, and the work was well advanced throughout the Gulf States. Some corn had been planted in Missouri and as far north as central Kansas, and a large acreage of fall-plowed ground was ready for seeding in Iowa. In Texas the crop was in good condition and receiving its first cultivation.

The least favorable reports respecting winter wheat were received from the States of the Ohio Valley, the crop having sustained much damage from overflows in Indiana and Illinois and portions of Ohio, and also in Michigan. A considerable acreage in Indiana and Ohio was so damaged that it was thought necessary to plow it up for other crops. An improvement, however, was noted in portions of Ohio and Illinois, and the general outlook in Missouri, Kansas, and Nebraska was encouraging, although rain was needed in the western portion of the wheat region in Nebraska. Over the southern portion of the Middle Atlantic States there was a general improvement; on the North Pacific coast conditions were very favorable, and a fair crop was promised in California, except in the flooded sections and in portions of the southern counties.

Spring-wheat seeding was in full progress and well advanced over the southern portion of the spring-wheat region until interrupted by the severe rain and snow storm of the 7th and 8th.

Cotton planting was interrupted by cold, wet weather in the central portion of the cotton belt, but progressed favorably in the southern portions of the eastern and western sections. Early planted cotton was up to satisfactory stands in the southern portions of Georgia, Alabama, and Louisiana, and in Texas. About three-fourths of the crop had been planted in the southwestern and central counties of the last-named State.

ADVANCE IN SPRING SEEDING AND PLANTING.

April 18.—Generally east of the Rocky Mountains the week was unseasonably cold and very unfavorable for germination and growth. Farm work in the Missouri Valley and Southern and Middle Atlantic States made very favorable progress, but in the northern districts practically nothing was done. The States of the upper Lake region were covered with snow to a considerable depth during the latter part of the week, and frosts more or less injurious occurred as far south as the northern portion of the Gulf States. The Pacific Coast States and Rocky Mountain districts experienced a week of highly favorable temperature conditions, but severe drought continued from central and western Texas to the South Pacific coast.

Preparations for planting corn were active in the Missouri Valley and Middle Atlantic States, but made slow progress in the Ohio Valley. In the Southern States low temperature proved unfavorable by checking germination and growth.

In Missouri and over most of Kansas and Nebraska winter wheat made good growth, but needed warmer weather. Reports from the Ohio Valley continued very unfavorable, although a slight improvement in southern Indiana was indicated. In Illinois wheat made little growth. Winter wheat made splendid growth on the Pacific coast, especially in Washington and Oregon.

Over the southern portion of the spring-wheat region seeding was actively carried on and was nearly finished in Iowa, Nebraska, and southeastern South Dakota, but in North Dakota and Minnesota very little had been done. Seeding was also in active progress on the North Pacific coast.

Cotton planting had progressed rapidly throughout the central and southern portions of the belt and had begun in the more northerly districts. In portions of Georgia and Texas planting was nearly finished and chopping had begun in Florida and southern Georgia, Throughout the belt the weather was too cold for germina-

tion and growth, the reports indicating that considerable replanting would be necessary in portions of the central and western districts.

Fruit experienced a week of trying conditions throughout the central valleys and Middle Atlantic and Southern States, but while the reports indicated that much injury had been done by frosts and freezing temperature, good prospects, due principally to the lateness of the season, continued in many sections.

GOOD PROGRESS IN PLANTING IN FACE OF LOW TEMPERATURES.

April 25.—From the west Gulf coast northwestward to the Middle Rocky Mountain slope the temperature was generally favorable, but elsewhere the week was too cool for germination and growth. Heavy rains in the lower Missouri Valley and portions of the spring-wheat region interrupted work, while droughty conditions in the Middle, South Atlantic, and Gulf States generally increased. Freezing temperatures and frosts generally throughout the central valleys, Lake region, New England, and the Middle Atlantic States were injurious to a greater or less extent.

While preparations for corn planting were active, but little was done, owing to low temperature. East of the Mississippi River no corn had been planted north of the Ohio River, nor had planting begun in Iowa and Nebraska, except in the southwest part of the last-named State. In the Southern States corn suffered from cold weather.

Very favorable reports respecting winter wheat were received generally from Nebraska and Kansas. In the States east of the Mississippi River the outlook was less favorable, although warmer weather the latter part of the week caused some improvement in Ohio. A large acreage in Indiana was being devoted to other crops. On the Pacific coast winter wheat experienced a general improvement.

Over the northern portion of the spring-wheat region practically no seeding had been done, and in North Dakota, where about one-half the crop was sown at this time last year, most of the lowlands were flooded. Seeding was generally well advanced over the southern portion.

Cotton planting was general over the northern portion of the belt, and was nearly finished in the central and southern portions, where chopping was in general progress, the early planted in Texas and Florida receiving its first cultivation. Over most of the central and eastern districts the stands were unsatisfactory and much replanting was necessary.

UNSEASONABLY COOL, WITH DAMAGING FROSTS.

Tobacco plants were injured by frost in Virginia and Kentucky, and were reported as small in Tennessee and North Carolina. Some transplanting had been done in South Carolina.

Generally throughout the central valleys and Middle Atlantic States the outlook for most fruits was further impaired, early peaches apparently suffering most.

May 2.—The northern Rocky Mountain districts and the States of the upper Missouri Valley experienced a week of favorable temperature, but throughout the Southern States, Ohio Valley, and the greater part of the Middle Atlantic States and New England it was too cool for germination and growth. Rains prevented farm work in the Ohio Valley and Tennessee and in portions of the lower Lake region, Middle Atlantic States, and New England, while drought in the south Atlantic and east Gulf districts and over the southern Rocky Mountain region and western Texas continued with increased severity. In California and Oregon, as in the previous week, it was unseasonably cool, with damaging frosts in Oregon, but in Washington the conditions were generally favorable.

With the exception of Kansas, southern Missouri, and Arkansas, corn planting progressed slowly, but preparations were extensive. In the east Gulf States and Tennessee corn suffered from drought and low temperatures. In the central and west Gulf States some received final cultivation.

In Nebraska, Kansas, and Missouri winter wheat advanced favorably, except where damaged by floods in the last-named State. In Illinois, Ohio, Kentucky, Tennessee, the Virginias, Maryland, and North Carolina an improvement was indicated, but in Indiana, Ohio, Pennsylvania, and Michigan the outlook was poor. The crop had advanced favorably on the Pacific coast.

Unseasonably cool weather generally throughout the cotton belt was unfavorable for germination and growth of cotton, and poor stands were extensively reported, especially in the central and eastern districts, where drought was also proving injurious. Planting was nearly finished, except in the northern portion of the belt and in the extreme western cotton counties of Texas, in which State the stands were generally good. Chopping was in general progress over the southern portion, and cultivation had begun in Louisiana and Texas.

BENEFICIAL RAINS—IMPROVEMENT IN WHEAT.

May 9.—The temperature conditions were favorable in all districts with the exception of the north Pacific coast and middle Rocky Mountain region, where frosts and freezing temperatures were injurious. Heavy rains in portions of the lower Missouri and Red River of the North valleys and in Texas retarded work and caused damage by washing land, but were of great benefit in relieving the droughty conditions in western Texas. Drought was also relieved in portions of the south Atlantic and east Gulf States, but continued over a large part of these districts, and rain was generally needed in the Middle Atlantic States. The States of the Ohio Valley and Lake region experienced a week of highly favorable conditions.

Corn planting proceeded under very favorable conditions throughout the northern portion of the corn belt. In Nebraska, Kansas, and northern Missouri, however, planting was interrupted by rains. In Iowa the work made good progress. Over the southern portion of the Middle Atlantic States planting was well advanced and had begun in Pennsylvania and New Jersey.

A general improvement in the condition of winter wheat was indicated, especially over the western portions of the winter-wheat belt and in the Middle Atlantic States, but the outlook for this crop in the States of the Ohio Valley continued very poor.

Spring-wheat seeding was largely finished, except on wet lands in the northern portions of North Dakota and Minnesota. The early sown over the southern portion of the spring-wheat region was making good growth. On the north Pacific coast the week was too cool for rapid advancement.

The cotton belt experienced favorable temperatures and abundant rainfall, except in the eastern districts. Reports of poor stands of early planted cotton continued from the central and eastern portions, but better stands of the late planted were indicated. Recent rains improved the situation in western Texas, but interfered with cultivation in the eastern portions of that State. Planting was nearly finished in northern districts.

DAMAGE BY COOL WEATHER, FROST, DROUGHT, AND BOLL WEEVIL.

May 16.—The week was much too cool in all districts east of the Rocky Mountains. Light to heavy frosts occurred over the northern portion of the central valleys and Middle Atlantic States and in the Lake region, with more or less injury. Light local rains afforded relief over limited areas in the South Atlantic and east Gulf States, but the greater part of these districts continued to need rain, and in some sections drought was severe. The week was also too cool on the north Pacific coast, but there was ample heat in California.

While corn planting was delayed in portions of Nebraska, Iowa, and Missouri, it made favorable progress in the States of the Missouri and upper Mississippi valleys, and proceeded uninterruptedly in the Ohio Valley. Planting was in progress in the Dakotas, Minnesota, Michigan, and New England, but had not begun in Wisconsin and New York. In Texas the crop was in fine condition and well cultivated, and was tasseling in the southern part. In the South Atlantic and central and east Gulf States corn was generally backward.

In Nebraska, Kansas, and Missouri the advancement of winter wheat was favorable and an improvement was generally reported elsewhere east of the Rocky Mountains, but the condition of the crop in the States of the Ohio Valley continued very poor. Wheat was now heading as far north as the southern portions of Kansas and Missouri, and harvest had begun in southern Texas. On the north Pacific coast the bulk of the crop was in promising condition, and, while a fair crop was indicated in California, the outlook in that State was not as good as earlier in the season.

Heavy rains prevented the completion of spring-wheat seeding in portions of North Dakota and northern Minnesota, but seeding was practically completed elsewhere. The early sown was coming up and growing nicely in the Dakotas and southern Minnesota, but variable conditions were reported from Iowa. In Washington the crop suffered from cold, but the outlook in Oregon was more favorable.

Cool weather was unfavorable for cotton throughout the cotton belt, and drought in portions of the eastern districts proved detrimental. Complaints of poor stands continued from nearly all sections in the central and eastern districts, but good stands were the rule in Louisiana, Oklahoma, and Texas. In the last-named State the fields were generally clean, and the plants were beginning to fruit in the coast districts. Chopping was well advanced, and cultivation in the southern districts was general. Boll weevils appeared and were increasing in a number of southwest and south-central cotton counties of Texas.

TEMPERATURES MORE FAVORABLE, WITH CORN PLANTING PROGRESSING WELL.

May 23.—While the fore part of the week was much too cool in the districts east of the Mississippi River, as a whole the temperature conditions were much more favorable than in the preceding week, the States of the Missouri Valley and the Rocky Mountain and Pacific coast districts having experienced highly satisfactory temperatures. Generally light rainfall in the central valleys and over most of the Southern States permitted the favcrable progress of farm work, complaints of interruption being confined mainly to the upper Ohio Valley. Complaints of wet soil, however, continued from portions of the central Mississippi and lower Missouri valleys. Drought continued in the South Atlantic and east Gulf States and over the southern Plateau region, and the need of rain was beginning to be felt in central and eastern Texas and on the north Pacific coast. Frosts, more or less damaging, occurred on the 16th and 17th in the Lake region, upper Ohio Valley, and Middle Atlantic States.

Corn planting advanced very favorably, except in portions of the central Mississippi and Ohio valleys, where it was prevented by wet soil. In Iowa, Nebraska, and Kansas planting was nearly completed, but in Missouri it was only about one-half finished, and much remained to be planted in the Ohio Valley. In the central and east Gulf States corn was generally small and backward, but it made good growth in Texas. Cutworms were very destructive in Kentucky, Tennessee, and portions of the Middle Atlantic States.

Winter wheat advanced favorably in Nebraska and Kansas and generally in Missouri. Improvement was reported from Illinois, Michigan, and Ohio, where however, the condition of the crop was very poor. In the Middle Atlantic States a general improvement in the crop was also noted. On the Pacific coast winter wheat sustained slight damage from drying winds in California, but the crop continued to do well in Oregon and Washington.

Spring-wheat seeding was practically finished, except in North Dakota, where it was well advanced.

Cotton continued backward and made slow growth during the week throughout the cotton belt, low night temperatures being generally reported as detrimental. Improved stands were reported in portions of the central and eastern districts, but irregular stands were the rule. Chopping continued and the fields were mostly well cultivated. Lice were very extensively reported from the central and eastern districts and boll weevils continued to increase in the southwestern and central cotton counties of Texas.

Nearly all reports respecting the grass crop were favorable.

CORN AND WHEAT IN GOOD CONDITION—COTTON SMALL, BUT PROMISING.

May 30.—With the exception of the northern Rocky Mountain region and upper Missouri and upper Mississippi valleys, where the early part of the week was too cool, the temperature was favorable in all districts. Oklahoma and portions of Iowa, Missouri, Wisconsin, Ohio, and Pennsylvania suffered to some extent from excessive moisture, while drought continued over a large part of the South Atlantic and East Gulf States. Well-distributed and beneficial rains fell over the greater part of Texas and the central Rocky Mountain slope. Light frosts occurred in Wisconsin and heavy and damaging frosts in Montana, Idaho, and the eastern portions of Oregon and Washington. Continued northerly winds caused considerable damage to fruit and possibly injured grain in California. Rain was generally needed on the north Pacific coast..

Except in the more northerly sections, where corn planting was much delayed, this work progressed under favorable conditions. A general improvement in the condition of corn was indicated in the Southern States.

A general improvement in winter wheat was indicated in the principal wheat States, but the crop continued very poor in the Ohio Valley. Harvest was in progress in the Southern States. On the north Pacific coast winter wheat did well, except in portions of eastern Washington, where it was injured somewhat by frost. In California the crop was maturing rapidly, but probably sustained injury by desiccating winds.

Early sown spring wheat was growing nicely, and the general outlook for this crop in the spring-wheat region was promising.

Nearly all reports respecting oats indicated that this crop had made very favorable progress. Early oats were heading as far north as the central Mississippi Valley and and the southern portion of the Middle Atlantic States. Harvesting continued in the South.

Although cotton continued small, a general improvement was indicated, especially in the central and western districts, where rains were well distributed and generally ample. The least favorable reports were received from Georgia, Florida, and portions of South Carolina, where drought continued. Lice were not so generally reported in the central and eastern districts as in the previous week, except in Georgia, but boll weevils continued to increase in the southwest and central cotton counties of Texas.

In the principal hay producing States the condition of this crop was uniformly good. Haying had commenced in Texas.

WEATHER UNFAVORABLE TO CORN, BUT MAINLY GOOD FOR WHEAT AND COTTON.

June 6.—While too cool for best results in portions of the Lake region and in the Missouri Valley and northern Rocky Mountain districts, with excessive moisture and lack of sunshine in the central Mississippi and lower Missouri valleys, the week, as a whole, was very favorable in the districts east of the Rocky Mountains. Drought in the South Atlantic and east Gulf States was very generally relieved, although more rain was needed in portions of Florida and in the central and west Gulf coast districts. The north Pacific coast experienced a favorable week, but in California nearly all crops were injured by continued drying north winds.

Over the western portions of the corn belt corn was checked in growth by lack of warmth and sunshine, and was much in need of cultivation, while in the central and eastern districts planting and replanting were delayed by rains. Poor stands were reported from the Lake region, Ohio Valley, and Middle Atlantic States.

Winter wheat suffered somewhat from heavy rains in portions of Oklahoma and Missouri; elsewhere the crop advanced favorably, but the outlook over the eastern portion of the winter-wheat belt continued unpromising, although more or less improved in the Ohio Valley and Middle Atlantic States. Wheat was heading as far north as the central Mississippi Valley, harvesting being general in the Southern States. On the north Pacific coast the crop had advanced favorably, and was heading; in California it was maturing rapidly, the late sown having been seriously damaged by hot winds.

With the exception of some weedy fields in South Dakota, spring wheat was in very promising condition.

Oats made vigorous growth throughout the central valleys and Middle Atlantic States, and a general improvement in condition was indicated in nearly all districts.

There was quite a decided improvement in the condition of cotton over nearly the whole of the cotton belt, although the crop suffered some damage in Oklahoma and Indian Territories from overflows, and from insufficient moisture in scattered localities in Louisiana. Rapid growth and a good state of cultivation were generally indicated. Boll weevils were increasing rapidly and doing considerable damage in a number of southwestern and south-central counties in Texas.

TEMPERATURES UNFAVORABLE, WITH TOO MUCH RAIN.

June 13.—In the central and western Gulf States favorable temperatures prevailed during the week, but elsewhere east of the Rocky Mountains and on the north Pacific coast complaints of insufficient heat were quite general, while hot, northerly winds caused further injury to nearly all crops in California. There was too much rain in portions of Texas, Arkansas, Oklahoma, Kansas, and North Dakota, and also over the northern portions of the Middle Atlantic States and New England, while lack of moisture was beginning to be felt in the Ohio Valley and portions of the upper Mississippi Valley and upper Lake region. In these last-named districts, however, the conditions were very favorable for farm work. Frosts on the 11th in the middle and northern plateau districts and in the eastern portions of Oregon and Washington proved injurious.

Throughout the central valleys and Middle Atlantic States corn made slow growth, and in Kansas and Nebraska much of the crop was still weedy, although it was in an improved state of cultivation. In Iowa, Missouri, Illinois, and Indiana fields were generally clean, but in the Middle Atlantic States rains interfered with cultivation. In Texas a good yield of corn was now assured, and the crop was promising elsewhere in the Southern States.

As a whole, winter wheat continued to advance favorably, a general improvement being indicated in the Ohio Valley and Middle Atlantic States. Harvest began in southeastern Missouri and southern Texas, and some wheat was ready for harvest in southern Kansas, where wet soil prevented commencement of this work.

Spring wheat continued to make satisfactory progress, and was in very promising condition.

The outlook for oats was very promising. They were heading as far north as Kansas, Missouri, and Tennessee.

A further improvement in cotton was generally indicated. In portions of Louisiana, Texas, and Oklahoma, however, fields were becoming foul, while the crop was in need of rain in portions of Alabama. In the central and eastern districts the plant continued small, but was growing rapidly. Boll weevils were still numerous in southwestern and central cotton counties of Texas, and in some sections were doing considerable damage.

A fine crop of hay was generally promised in nearly all sections.

CROP GROWTH SLOW—PROGRESS OF WHEAT HARVEST.

June 20.—Continued cool weather in the districts east of the Mississippi River was unfavorable, but to the westward of the Mississippi the temperature was very favorable, the week averaging the best of the season in the northern Rocky Mountain districts. While high maximum temperatures occurred in California, the conditions there had improved since the previous week. A large part of the Gulf States and most of New England received little or no rain, and moisture was needed in those districts. Portions of the Lake region, Ohio Valley, and Tennessee were also beginning to need rain, while too much fell in eastern Kansas and southeastern Nebraska. Unseasonably low minimum temperatures occurred in the Atlantic coast districts on the 14th and 15th, with light frosts in central New Jersey.

As a whole, corn made slow growth in the principal corn States and was generally reported as small. Good growth, however, was reported from Oklahoma and Kansas, and the crop continued to do well in the Southern States, though it needed rain.

A general improvement in winter wheat was indicated in nearly all districts.

Spring wheat made rapid growth and was in promising condition, although weedy in North Dakota.

Less favorable reports concerning oats were received from Missouri, where the crop was heading short, and from Illinois and Michigan, where it was in need of rain and warmth; elsewhere the general outlook continued promising.

The favorable progress of cotton during the two preceding weeks was checked in the central and eastern portions of the belt, where rain was generally needed and lice were extensively reported. In Tennessee and portions of the Carolinas and southern Mississippi, however, the crop continued to do well, and throughout the cotton belt it was well cultivated, except in northeastern Texas, where a few fields were still foul. In the last-named State cotton made rapid growth and was generally in fine condition, but boll weevils caused damage in a greater number of counties than in the preceding week. Good growth was also reported from Oklahoma, Indian Territory, and Arkansas.

In portions of the Lake region and Ohio Valley grass suffered materially from lack of moisture, but elsewhere the outlook for the hay crop continued very promising.

CORN GOOD—COTTON SMALL, BUT WELL CULTIVATED.

June 27.—The temperature conditions in the districts east of the Mississippi River were more favorable than in the preceding week, but were less so in the upper Missouri Valley and in the Rocky Mountain and north Pacific coast districts, where it was abnormally cool, with heavy frosts, more or less damaging, in the eastern portions of Washington and Oregon and in Utah, Idaho, and northern Arizona. Rain was generally needed in the Lake region, Ohio Valley, and the Atlantic coast and east Gulf States, although portions of these districts received generous rains, while the States of the lower Missouri Valley and portions of Minnesota and North Dakota suffered from excessive moisture. On the Pacific coast the weather conditions were more favorable in California, but Oregon and Washington suffered considerably from drought and low temperatures.

In Iowa and in the principal corn States eastward of the Mississippi River corn made good progress and was well cultivated, rapid growth being generally reported. Rapid growth was also reported from Missouri, Kansas, and Nebraska, but in these States cultivation was hindered, particularly in Missouri and Nebraska, where many fields were grassy. A large crop was practically assured in Texas, but drought impaired the outlook in the central and east Gulf and South Atlantic States.

The progress of wheat harvest in Kansas and Missouri was interrupted by rains, but the work proceeded without interference eastward of the Mississippi River, and was in progress as far north as the southern portions of Illinois and Indiana, and in

Virginia and Maryland. Some lodging and rust were reported from Nebraska and Missouri, and dry weather hastened maturity in Michigan; but elsewhere the crop advanced favorably, well-filled heads being generally reported.

Spring wheat was somewhat less promising than previously indicated, but the outlook continued encouraging in the spring-wheat region east of the Rocky Mountains. In portions of the Dakotas the crop was weedy, but in these States and in Minnesota it made good growth and the early sown was beginning to head.

In most of the districts east of the Mississippi River cotton made slow growth and was generally small, though healthy and well cultivated. Good growth, however, was reported from Mississippi and portions of Alabama, and while lice were increasing in the last-named State they were less numerous in Mississippi and South Carolina. West of the Mississippi River the advance of the crop was more rapid, good growth being generally reported; and while some fields were foul in portions of Texas, Arkansas, and Louisiana, the crop was generally well cultivated. In Texas boll wevils were more numerous in the southwestern, central, eastern, and coast sections.

HARVESTING OF WINTER WHEAT, OATS, AND HAY.

July 4.—In the Lake region and central valleys the week was unseasonably cool and unfavorable for rapid growth, but highly favorable temperatures prevailed in the Southern States and in the Rocky Mountain and Pacific coast districts. East of the Rocky Mountains the rainfall, as a whole, was well distributed and ample, too much occurring in the lower Missouri Valley and the valley of the Red River of the North. Portions of the South Atlantic and east Gulf States continued to need rain, although droughty conditions in these districts were largely relieved. Rain was much needed on the immediate north Pacific coast.

In Nebraska and Kansas corn grew well, but in the central and eastern portions of the corn belt growth was slow, as a result of cool weather. Except in portions of Nebraska, Kansas, and Missouri, where fields were weedy, the crop was in a good state of cultivation.

Winter-wheat harvest made slow progress in Missouri and Kansas, and damage to wheat in shock was reported from the first-named State. Complaints of rust were also received from portions of Missouri and from Nebraska and Kansas. East of the Mississippi River better harvesting weather prevailed.

In the northern portion of the spring-wheat region cool, wet weather checked rapid advancement of spring wheat, which, however, was generally doing well. Over the southern portion of the spring-wheat region the reports indicated an improvement over the previous week.

The general outlook for oats was promising, but the crop suffered from excessive moisture on lowlands in Minnesota and in portions of Missouri, Nebraska, and Oklahoma.

An improvement in cotton was generally indicated, and, while the plant continued small in the central and eastern districts, it was making rapid growth throughout the belt, especially in the central and western districts. The crop was generally well cultivated, although some fields in Oklahoma and northeastern Texas were foul. Cotton was beginning to open in the extreme southwestern coast counties of Texas.

While rains injured hay in portions of the lower Missouri and Ohio valleys and New England, a good crop was generally promised.

DAMAGING RAINS—INJURIES BY RUST AND BOLL WEEVIL.

July 11.—Unseasonably cool weather continued in the States of the Missouri Valley and over the western part of the upper Lake region, but elsewhere the temperature was very favorable. Heavy rains prevented cultivation of crops and greatly interfered with harvesting in the lower Missouri, central Mississippi, and Ohio valleys and in portions of the Middle Atlantic States and Lake region, and much grain in shock was damaged in Oklahoma, Kansas, and Missouri. Portions of the South Atlantic States and north-central Texas needed rain, and in the southern plateau districts severe drought continued. Drought also prevailed in the coast districts of Washington and Oregon, where crop prospects were materially lessened.

Over the greater part of the corn belt corn made vigorous growth, but continuous rains prevented cultivation, and much of the crop was weedy. In the more northerly districts corn was generally backward, but had advanced decidedly.

Winter wheat sustained great damage from continuous heavy rains in Nebraska, Kansas, Oklahoma, and Missouri, where the unharvested grain was seriously damaged by rust and lodging and that in shock by molding and sprouting. Harvesting

was also greatly hindered in the districts east of the Mississippi River, where, however, the conditions were much less serious than in the States of the lower Missouri Valley.

While spring wheat suffered slightly from rust over the southern portions of the spring-wheat region and was thin and weedy on lowlands in northern Minnesota, the crop, as a whole, advanced satisfactorily. It was now heading in North Dakota and northern Minnesota. On the north Pacific coast spring wheat, especially the late sown, suffered seriously from dry weather.

Cotton grew rapidly throughout the cotton belt, complaints of too rapid growth being received from portions of the central districts. Over the greater part of Texas and in the eastern districts the crop was in a good state of cultivation, and comparatively little damage from insects was reported, except in Texas, where boll weevils were increasing and becoming more destructive in the southwestern counties.

Haying was greatly retarded by rains throughout the central valleys and Middle Atlantic States, and much hay was spoiled. Better conditions prevailed in Minnesota, the Dakotas, Nebraska, and Montana, where a fine crop was being gathered.

CONTINUED DROUGHT IN SOUTHERN PLATEAU REGION—RAPID GROWTH OF CORN.

July 18.—East of the Rocky Mountains the temperature was highly favorable, but in the Pacific coast States and over the western portions of the middle and northern plateau districts it was unseasonably cool, with light to heavy frosts on the 13th in Washington and Oregon. Too much rain hindered farm work in the central Gulf districts and in portions of the Ohio Valley and Middle Atlantic States, while need of rain was beginning to be felt in northern New England, portions of the Carolinas, over the greater part of Texas, and in southern Colorado. Drought was relieved in the North Pacific coast districts, but continued with increased severity in the southern plateau region.

Corn experienced a week of exceptionally favorable weather conditions and made rapid growth generally. Very few unfavorable reports respecting this crop were received. In the Missouri Valley and in portions of the upper Ohio Valley and Middle Atlantic States, however, the crop suffered somewhat from lack of cultivation, and in Texas the late planted was being injured by drought.

Better weather for harvesting winter wheat prevailed than in the preceding week, and the work made satisfactory progress, although delayed by moisture in portions of Kansas and the Ohio Valley. Harvesting was practically completed in Missouri and Nebraska, and was well advanced in the Ohio Valley and the northern portion of the Middle Atlantic States. Comparatively few reports of sprouting in shock and of damage by mold were received this week. Harvesting continued under favorable conditions on the Pacific coast.

Reports of injury to oats by rust continued from the lower Missouri Valley, but elsewhere this crop advanced favorably, harvest being in general progress in the central valleys and Middle Atlantic States, with satisfactory yields.

Cotton continued to make rapid growth throughout the cotton belt, with the exception of Texas, where its advancement was checked by dry weather. From portions of the Carolinas, Florida, Alabama, Mississippi, and Louisiana complaints of grassy fields were received, and in some sections of these States too rapid growth of stock was reported. In Georgia the crop was in very promising condition, little complaint of damage from any source being received from that State. Dry weather and abundant sunshine checked the ravages of the boll weevil in Texas.

WEATHER GENERALLY FAVORABLE—COTTON PICKING BEGUN IN TEXAS.

July 25.—While rather cool for best results in the Lake region and portions of the central valleys, with lack of sunshine and too much rain in the Middle Atlantic and central Gulf States, the weather conditions of the week, as a whole, were favorable. With the exception of portions of the central Missouri Valley excellent weather for harvesting and thrashing prevailed in the central valleys, where harvesting was nearly finished and thrashing made rapid progress. Quite generous and much-needed rains occurred in the middle and southern Rocky Mountain districts, partially relieving the severe and protracted drought.

While higher temperature in the extreme northern portion of the corn belt would have been more favorable, corn made excellent growth and was generally in most promising condition. The crop was now largely laid by in a satisfactory state of cultivation, the early planted being in silk and tassel as far north as Nebraska, Iowa, and Illinois.

Oat harvest continued under favorable conditions and was nearing completion in the lower Missouri and upper Mississippi valleys. In the more northerly sections the maturing crop was very promising.

Cotton suffered to some extent from lack of cultivation and too rapid growth in portions of the central districts, and while shedding and rust were reported in places elsewhere, the crop generally did well. Bolls were now opening in the more southerly portions and picking had begun in Texas, where ample rains relieved the droughty conditions prevailing at the close of the previous week. Boll weevils appeared in two border parishes of Louisiana adjacent to the area affected in Texas, but as yet were causing no material injury.

Tobacco continued to do well in nearly all tobacco States, the least favorable reports being received from North Carolina and Kentucky. The crop had sustained some damage from local storms in North Carolina; and in Kentucky, though doing fairly well, was rather uneven. Topping of early planted tobacco was in general progress in the Ohio Valley and Middle Atlantic States.

RUST IN SPRING WHEAT—GOOD HAY YIELDS.

August 1.—Very favorable temperatures prevailed during the week in nearly all districts, and, while droughty conditions were beginning to be felt over limited areas in the central valleys and Southern States, the rainfall was generally ample for crop needs.

Corn experienced a week of favorable temperature, and while needing rain in portions of the Ohio, central Mississippi, and Missouri valleys, the crop, as a whole, made good progress and continued in promising condition.

Thrashing winter wheat advanced under favorable weather conditions in the central valleys, but frequent rains interrupted the work in the Middle Atlantic States. The quality and yield of grain proved disappointing in the lower Missouri Valley, where the crop suffered much from excessive rains during the period of harvest.

Unfavorable reports respecting spring wheat were more pronounced as well as more general than in the previous week, rust being more or less prevalent in all of the principal spring-wheat States east of the Rocky Mountains. In portions of Minnesota and North Dakota, however, a good crop was promised. Harvesting was in progress in Iowa, Nebraska, and South Dakota.

Cotton made good growth in the central and eastern portions of the cotton belt, too rapid growth being reported from portions of Alabama, Mississippi, and Louisiana. Complaints of rust and shedding were more general than in the previous week in the Carolinas, Georgia, and Florida. Shedding was also generally reported from Texas, where most of the crop needed rain, drought being most serious in the north-central counties. Much of the crop in Mississippi and Louisiana was grassy. Picking continued in southern Texas and began in Alabama and Florida.

The condition of tobacco was less favorable in the Ohio Valley, where much of the crop was in need of rain, but from Virginia northward tobacco made good growth and topping was in progress.

Rains interrupted haying and damaged hay in the Middle Atlantic States, but elsewhere a large crop of generally fine quality was mostly secured.

Plowing for fall seeding commenced in the Middle Atlantic States, southern Illinois, and Oklahoma.

EXTREMES OF WEATHER CONDITIONS—CORN IRREGULAR IN GROWTH—FALL PLOWING.

August 8.—The weather conditions during the week were less favorable than in the previous week. The central and east Gulf and Atlantic coast districts, except northern New England, suffered from excessive rains, while droughty conditions in the central valleys and portions of the upper Lake region became more serious. Generally sufficient rainfall afforded relief in Texas. In Wisconsin, Minnesota, and the Dakotas the week was too cool, while Idaho, Washington, and Oregon suffered from excessive heat and dryness. Killing frost occurred on the morning of the 8th in the cranberry region of Wisconsin.

In the Ohio Valley corn, the late planted especially, was suffering more or less seriously from drought, and rain was needed for this crop in portions of the central Mississippi and lower Missouri valleys. Over the central and western portions of the corn belt, however, corn advanced favorably and continued promising. In the upper Lake districts lack of warmth and absence of rain checked growth, the crop being generally backward. In the Atlantic coast districts corn made vigorous growth and generally was in excellent condition.

Fine weather for thrashing prevailed over most of the winter-wheat belt, harvesting of winter wheat having been completed in the more northerly districts, except on the north Pacific coast, where it was nearly completed.

Reports of rust in spring wheat continued general in the Dakotas and in portions of Iowa and Minnesota, and indicated that the crop had been greatly damaged, except in Minnesota, where only a portion of the spring-wheat area had been seriously affected, a good crop being promised in other portions of that State.

Generally well-distributed rains benefited cotton in Texas, but in the central and eastern portions of the cotton belt the crop suffered from excessive moisture, many fields being grassy, and too rapid growth, rust, and shedding were reported from nearly all States east of the Mississippi River. West of the Mississippi, with the exception of Louisiana, the crop was in a good state of cultivation, and complaints of rust and shedding were less numerous than in other districts.

In the Atlantic coast districts and in Tennessee tobacco continued promising, but in the Ohio Valley it was suffering from drought.

Plowing for fall seeding became more general, but the soil was not in favorable condition for the work in the Ohio Valley and much of the Lake region.

DROUGHT IN CORN REGION, RUST IN SPRING WHEAT, BOLL WEEVIL IN COTTON.

August 15.—The Atlantic coast and east Gulf districts suffered from excessive moisture and lack of sunshine, a large part of the central valleys from drought, the Lake region from low temperatures, and the northern Rocky Mountain and north Pacific coast districts from heat and drought. The temperature was favorable over the eastern Rocky Mountain slope and in the central valleys and Middle and South Atlantic States.

Rain was needed generally throughout the corn belt, over a large part of which, more particularly the southern and eastern portions, corn was suffering more or less seriously from drought. In the central Missouri Valley, while needing rain, corn made good growth and was in promising condition, but in the Ohio Valley and Tennessee there was a marked deterioration in the condition of the crop, some in Indiana having been injured beyond recovery. In Iowa corn made satisfactory progress and a normal yield was promised. In the Southern States early corn was being gathered, cutting being in progress as far north as southern Kansas. An excellent crop was now practically assured in the Middle Atlantic States. In the Lake region and the Dakotas corn was backward and growing slowly.

The weather was favorable for spring-wheat harvest, which was far advanced in the southern portion of the spring-wheat region, and the crop was ripening rapidly in the extreme northern portion.

A more or less decided deterioration in cotton was indicated over much the greater part of the cotton belt. With the exception of Oklahoma, complaints of shedding were received from every State, and rotting of the lower bolls was reported from portions of the central and western districts. Reports of too rank growth, however, were much less numerous than in the preceding week, but continued from portions of the central and eastern districts. Boll weevils were causing much damage in southwestern, central, eastern, and coast districts of Texas, and were proving destructive up to the northern tier of counties. In that State, however, the plant and fields were in good condition. In Oklahoma and Indian Territories, Missouri, and portions of Arkansas, cotton was doing well. Picking was general only in southern Texas, but had begun in the southern portion of the eastern districts, where, as a rule, very little was open.

Tobacco suffered much from drought in the Ohio Valley, but made satisfactory progress in the Middle Atlantic States and New England. Cutting was in progress in Ohio and Virginia.

MUCH NEEDED RAINS IN CENTRAL VALLEYS—IMPROVEMENT IN GROWING CROPS.

August 22.—The drought prevailing in portions of the central valleys was relieved by abundant rains, but drought continued in central and western Tennessee and was beginning to be felt in the middle Gulf States and over a considerable part of Texas. The central and northern Rocky Mountain districts and the north Pacific coast region were also suffering from drought, and forest fires were reported as being prevalent in Idaho and Montana. The latter part of the week was too cool in the Lake region and unseasonably low temperatures occurred in the northern Rocky Mountain districts and upper Missouri Valley on the 21st and 22d, but elsewhere east of the Rocky Mountains the temperature was favorable.

The principal corn States experienced a week of favorable conditions, abundant rains having fallen throughout the corn belt, except in portions of Ohio and Nebraska. Corn made satisfactory progress in the States of the Missouri Valley and was generally improved in the central Mississippi and Ohio valleys, although a considerable part of the crop in the Ohio Valley was injured beyond recovery. In the Middle Atlantic States and lower Missouri Valley early corn was now practically matured.

Spring-wheat harvest was now generally finished, except in North Dakota and northern Minnesota, where rust continued to cause great injury.

The general outlook for cotton was somewhat improved, as compared with the conditions reported the previous week, although shedding continued in every State and rust was prevalent in the central and eastern districts. The unfavorable effects of shedding and rust, however, were less pronounced than were previously reported. In Texas the weather conditions were favorable, but the crop continued to deteriorate as a result of rust and shedding and damage by insects. In this State injury by bollworms was decreasing, but the boll weevils continued very destructive in southwestern, central, eastern, and coast divisions, having caused entire absence of bloom in many localities. Picking was quite general in Texas, except in the north portion, and was in progress in the southern portions of the central and eastern districts of the cotton belt.

The reports respecting potatoes indicated that a good crop was generally promised in the more important potato-producing States. Drought impaired the outlook in portions of the Ohio Valley, however, and rot and blight were increasing in Pennsylvania.

Throughout the central valleys and Middle Atlantic States the soil was in fine condition for fall plowing, which work was in general progress and was well advanced in some places.

APPROACH OF FROST—POOR YIELDS OF SPRING WHEAT—CONDITION OF COTTON.

August 29.—While the latter part of the week was abnormally cool in the Ohio Valley, lower Lake region, Middle Atlantic States, and New England, the temperature, as a whole, was favorable for maturing crops. Portions of the south Atlantic and east Gulf States suffered from excessive rains, while drought prevailed over a large part of the central and west Gulf States. Occasional showers, very unusual for the season, occurred in central California, and there was more than the usual rainfall in the western plateau districts. Freezing temperature was reported from central Wyoming and light frosts from Colorado, Montana, and portions of Ohio, Pennsylvania, and New York.

Although cool weather prevented rapid development of corn in the Ohio Valley and Lake region, the crop, as a whole, experienced decided improvement. Much of that prostrated by winds in the previous week in Indiana and Illinois was straightening. In the Missouri Valley the temperature was more favorable and the advancement of the crop toward maturity was much more rapid than in the central Mississippi and Ohio valleys. Early corn was already matured in southern Missouri and was ripening rapidly in Nebraska and South Dakota, cutting being in progress in the first-named State and in Kansas. The reports indicated that from three to four weeks of favorable weather would be required to mature the late crop.

The week was practically rainless in the spring-wheat region of Minnesota and the Dakotas, affording favorable weather for harvesting and thrashing. Some early wheat in the northern portion of North Dakota was yet unripe, and rust was still damaging late wheat in that State. Disappointing yields were generally reported from Idaho, Washington, and Oregon.

In northern Alabama and in the southern portions of Mississippi and Louisiana cotton improved and the crop was in good condition in Oklahoma and Indian Territories, but elsewhere the reports generally indicated unfavorable progress. Deterioration from rust and shedding was reported from nearly all districts. Heavy rains proved injurious in portions of Florida and Georgia, while over a large part of Texas the crop suffered decidedly from drought. In the last-mentioned State bollworms continued destructive, and boll weevils were puncturing nearly all squares in southwestern, central, eastern, and coast divisions, and were causing much damage as far north as Dallas, Kaufman, and Hunt counties. Picking was in full progress in Texas and was general in the southern portions of the central and eastern districts.

Except in portions of New England and the Middle Atlantic States, where blight and rot were reported to a greater or less extent, an excellent crop of potatoes was indicated.

Good progress was made with fall plowing throughout the central valleys and Middle Atlantic States.

INCREASE OF RUST AND SHEDDING IN COTTON—MUCH TOBACCO HOUSED—LARGE CROP OF POTATOES.

September 5.—In the northern districts, from the upper Missouri Valley to the lower Lake region, the temperature was too low for best results, but favorable temperature prevailed in other districts. Heavy rains proved detrimental in the Dakotas, Minnesota, and Iowa, and in portions of the Carolinas, Florida, and Alabama, while the northern portion of the central Gulf States, Tennessee, the Ohio Valley, and much of the Middle Atlantic States and New England needed moisture. Rain was also needed on the north Pacific coast, but the southern plateau region and the eastern Rocky Mountain slope were favored by good rains.

As a whole the corn crop advanced satisfactorily, especially over the southwestern portion of the corn belt, where early corn was fully matured and considerable had been cut. In Arkansas, Tennessee, and portions of the Ohio Valley and Middle Atlantic States late corn needed rain.

About half the spring-wheat crop remained to be harvested in North Dakota, where rust was increasing and smut was appearing. In Minnesota harvest was completed, except on lowlands in the northern portion. Harvesting was nearly finished on the north Pacific coast, where the yield was lighter than the average.

A quite general deterioration in the condition of cotton was indicated, although improvement was reported from limited areas, principally in the central districts. Rust and shedding continued very generally prevalent. Drought proved detrimental in Tennessee, and drought and heat in Oklahoma and Texas, although rains, too late to be beneficial, fell over a large part of the last-named State, where boll weevils were destroying practically all new fruit, except in the north-central counties. Damage by boll weevils in Louisiana was restricted to a few small areas. Cotton was opening rapidly throughout the cotton belt and picking was general, except in the extreme northern portion.

The weather was very favorable for cutting and housing tobacco, a good crop of which was being secured in Ohio, the Middle Atlantic States, and New England. Further improvement was reported from Kentucky, where cutting was now general.

A large crop of potatoes was indicated in all districts, although prospects were somewhat impaired by drought in southwestern Ohio, and blight and rot were reported from New York, southern New England, and New Jersey.

PROGRESS IN CORN CUTTING, COTTON PICKING, AND FALL SEEDING.

September 12.—Nearly normal temperature, with no rain or very light showers, prevailed over the greater part of the central valleys and interior of the Southern States, while New England and the northern portions of the Middle Atlantic States and Lake region experienced temperature considerably below normal, light frosts occurring in the upper Lake region and upper Mississippi and upper Missouri valleys on the 11th and 12th. Portions of the South Atlantic and Gulf coast districts and Oklahoma, eastern Kansas, and portions of Iowa and Minnesota received considerable rain, excessive amounts being reported from southern Georgia and eastern Florida. Abnormal temperature extremes occurred in California.

The damage resulting from light frosts was mainly confined to Minnesota, Wisconsin, and upper Michigan, nearly the whole of the most productive part of the corn belt having experienced very favorable conditions for maturing the crop. Much corn was already safe, cutting being general in the central and southern portions of the corn belt, and being in progress as far north as South Dakota and southern Minnesota. Late corn suffered from drought in portions of the Ohio Valley and Middle Atlantic States.

The weather favored thrashing in the spring-wheat region. Harvesting, which had been much delayed in North Dakota, was finished, except some late grain.

While rust and shedding continued over a large part of the cotton belt, reports of injury from these causes were less numerous than in the previous week in the central districts. The weather was favorable for picking, except in portions of Georgia and Florida, where this work was hindered by heavy rains, and picking was now begun in the northern districts. In Texas cotton improved slightly in a few northern counties, but on the whole very little new fruit was forming and boll weevils were puncturing nearly all new squares in the southwestern, coast, central, and eastern counties, as well as in a number of northern counties.

In the Lake region, over the northern portion of the Middle Atlantic States, and in New England a fine crop of apples was promised, but over the southern portion of the Middle Atlantic States and the greater part of the central valleys apples were scarce and of indifferent quality.

Except in portions of New England and the Middle Atlantic States, where blight and rot in potatoes were extensive, a fine yield of this crop was generally indicated.

Dry soil retarded plowing and seeding in the Ohio Valley and Middle Atlantic States and over a large part of the Southern States, but good progress with this work was made in the Lake region and over the greater part of the upper Mississippi and Missouri valleys.

WEATHER AND INSECTS DAMAGING TO COTTON AND CORN—WINDS INJURE APPLES.

September 19.—While the weather conditions were generally favorable for gathering crops, low night temperatures in the more northerly portions delayed maturity of late crops, and some suffering from drought was reported from the Ohio Valley and lower Missouri valleys and portions of the Southern States. Frosts occurred as far south as Oklahoma and Tennessee, but little or no damage resulted, except to tender vegetation in the central valleys and to unmatured crops in Wisconsin, Minnesota, the Dakotas, and Montana. An unusually severe rain and wind storm caused considerable damage on the 14th and 15th in portions of New England and the Middle Atlantic States. The conditions were generally favorable in California, but drought was injurious in Oregon and no rain fell in Washington.

Late corn was maturing rapidly in the western portion of the belt, but the corn was ripening slowly in the eastern and central sections and needed ten to twenty days of favorable conditions to be safe from frost. While damaging frosts occurred in portions of the upper Mississippi Valley, and a considerable portion of the crop was damaged in Wisconsin and some on lowlands in parts of Minnesota and Iowa, the aggregate frost damage in the last-named State was not serious. Cutting was now general in all sections.

Spring-wheat harvest was practically completed, except in the northern portion of North Dakota, and thrashing was well advanced in Minnesota and South Dakota, half done in Washington, and nearing completion in Nebraska, but delayed by rain in eastern North Dakota.

Complaints of cotton shedding were still received from the eastern section and the northern portion of the western section of the cotton belt, but reports of rust were not so general. Except in North Carolina, the staple was opening rapidly in all districts, in some localities prematurely, and picking was general, although delayed by rain in portions of Texas, from which State, as well as from Georgia, scarcity of pickers was reported. Dry weather was causing injury to late cotton generally in the central and eastern sections, and a light or no top crop was indicated in the central and western districts, while worms and caterpillars were causing injury in Oklahoma, Louisiana, Alabama, and South Carolina. In Texas the boll weevils continued as damaging in southwestern, coast, central, eastern, and a number of northern counties as the advancement of the season permitted.

A light and inferior crop of apples was indicated in a majority of the States of the central valleys, but in Michigan and Ohio and the northern portion of the Middle Atlantic States, as well as in New England, this fruit was plentiful, especially in the last-named section, where a large crop of fine quality was promised. High winds of the 14th and 15th caused much damage to apples in portions of the Middle Atlantic States and New England.

Plowing for fall seeding was delayed by dry soil in the Ohio and lower Mississippi valleys, Nebraska, Indian Territory, and Georgia, and rain was needed in Michigan for germination. Elsewhere plowing was well under way, and seeding was general in most sections, some of the early sown wheat beginning to show green in Illinois.

KILLING FROST, BUT CORN AND TOBACCO SAFE—COTTON OPENING RAPIDLY.

September 26.—Unusually low temperature for the season was the marked feature of the week in the northern section of the country east of the Rocky Mountains, heavy to killing frosts having occurred on the 21st to 23d in New England, portions of the Middle Atlantic States and Lake region, Minnesota, and the Dakotas. In the central valleys and southern districts more favorable temperature prevailed. The rainfall was unequally distributed, being excessive in portions of the Gulf States and Oklahoma and abnormally heavy on the southern Pacific coast, where much damage resulted. Beneficial rains fell in Illinois, Indiana, lower Michigan, and portions of Iowa and Missouri, and showers delayed work in Minnesota and North Dakota, but elsewhere only light showers or no rain fell, the conditions being favorable for gathering late crops.

In the principal corn-producing States west of the Mississippi River late corn experienced favorable weather conditions; the crop was generally maturing rapidly, except in northern Missouri, with no material damage from frost. In Iowa a week

of warm and dry weather was required to mature the greater part of the late planted; needed ten days in Missouri; mostly safe from frost in Kansas, and the bulk of the crop was beyond injury by frost in Nebraska. East of the Mississippi River late corn ripened slowly on account of cool weather. In Illinois a part of the crop was safe in the southern portion; in Indiana much was in danger from frost, and in Ohio, while it was practically safe in the south, the staple required one to two weeks more in the north. Frosts caused some injury to corn in the northeastern part of the last-named State and considerable damage in New England, the northern portion of the Middle Atlantic States, the upper Lake region, and upper Mississippi Valley.

Cotton opened rapidly in all sections, prematurely in Georgia and Mississippi, and picking was being pushed, but was delayed somewhat by rains in Florida, Mississippi, Oklahoma, and Texas, and scarcity of pickers was reported from localities in central and eastern districts. Reports indicated that a very light top crop might be expected. The salient features of statements from the principal cotton-producing States, summarized, were as follows: Georgia, bulk of crop gathered and marketed in central and southern sections; Alabama, continued to rust and shed, but these adverse conditions were not so general as previously reported; Mississippi, open cotton injured in east by heavy rains, and bollworms causing damage in southwest; Louisiana, worms and caterpillars damaging, boll weevils locally numerous in one parish and spreading in another, crop deteriorated; Arkansas, very little shedding, but crop made only slight improvement; Texas, little injury to staple by showers, and the crop too far advanced for further damage by boll weevils.

Although damaged by high winds in New York, a good crop of apples was promised in that State; little injury was caused to apples by the recent freeze in New England, and a large crop of good quality was being picked in Michigan. Elsewhere a generally inferior crop was indicated.

Frosts caused damage to potatoes in New England, Michigan, and Wisconsin, and the crop was affected by rot in portions of the Middle Atlantic States and lower Lake region. Elsewhere potatoes promised fair to excellent yields of good quality.

Fall seeding was advancing under generally favorable conditions in northern districts, being practically completed in some sections, with early-sown wheat up to good stands in Oklahoma and showing green in Missouri and Illinois. Very little plowing was done in the Southern States on account of baked soil, and rain was needed in Minnesota, Nebraska, and South Dakota to put the soil in condition for the work.

COTTON PICKING AND FALL SEEDING WELL ADVANCED.

October 3.—The temperature conditions during the week were generally favorable for maturing and harvesting late crops, although excessively warm in portions of Kansas and the Southern States. Heavy to killing frosts, causing some damage, were reported from Wisconsin. There was practically no precipitation over the lower Missouri Valley and Southern States, but copious rains fell in New England, New York, Michigan, the Red River of the North Valley, portions of the lower Missouri Valley, and southern Plateau region, delaying work and injuring crops in some of these districts. Drought continued in the upper Ohio Valley, and moisture was needed generally in the Middle and South Atlantic States and portions of Oklahoma and South Dakota. The weather conditions were favorable in the Pacific coast States, but more rain would have been beneficial in Oregon.

Corn experienced another week of favorable conditions, but frost was injurious in Wisconsin, much was blown down and damaged in Illinois, and dry weather was needed in Iowa to prepare the crop for cribbing. Corn was practically safe in Nebraska; less than 5 per cent was in danger from frost in Michigan and eastern Kansas; 10 per cent in Ohio, central Indiana, Iowa, and South Dakota, and 20 per cent in northern and central Illinois and Missouri. Cutting was progressing rapidly in all sections, being practically completed in portions of southern Missouri, and nearing completion in Kansas.

With high temperature and practically no rain during the week in the cotton region, the staple continued to open rapidly in all sections, prematurely in Georgia and Mississippi, and picking progressed under favorable conditions. Complaints of scarcity of labor were still received from portions of central and eastern districts. Reports indicated that nearly all of the cotton crop had been harvested in southern Georgia and Louisiana and southwestern Texas; 75 per cent in Florida and the central portions of Georgia and Texas, and 50 per cent and over in other States, except Arkansas and Oklahoma, where about one-fourth was picked, and North Carolina, where only a small portion had been gathered. Late cotton was still shedding in Georgia, and much was shortened by drought in Tennessee, and continued depredations of insect pests injured prospects for any top crop in Texas.

High winds caused considerable damage to apples in New England, the northern portion of the Middle Atlantic States, Ohio, and Michigan, and a poor crop was generally indicated in the States of the central valleys. A good crop, however, was being picked in New England, and apples were better than anticipated in Pennsylvania and unusually good in Iowa.

While the soil was too dry for fall plowing in portions of Virginia and the upper Ohio Valley, the South Atlantic and east Gulf States, and Arkansas, this work, as well as seeding, was favorably advanced in other sections, and the early sown grain was germinating nicely and coming up to good stands in the central valleys and Lake region.

October.

The month of October was somewhat colder than usual on the Atlantic coast northward of the Carolinas and in the lower Lake region, but elsewhere the temperature was mild and the rainfall generally below the average, although excessive rains occurred in portions of Florida, Texas, the central Missouri and upper Mississippi valleys, and upper Lake region. Dry weather in the Ohio and lower Mississippi valleys and central Gulf, Middle, and South Atlantic districts was unfavorable for fall pasturage and hindered the progress of plowing and seeding. On the Pacific coast the weather conditions were favorable. Rains caused injury to fruit interests in central and northern California, but were otherwise very beneficial.

The reports generally indicated that the corn crop matured with a comparatively small percentage injured by cold. Over nearly the whole of the corn belt the weather during October was favorable for maturing, and by the close of the month husking and cribbing were well advanced.

Over most of the winter-wheat belt wheat seeding was nearly finished at the close of the month, and the early sown was up to good stands and in fine condition. Dry weather, however, over the southeastern portion of the belt prevented the completion of seeding and was unfavorable for germination.

As a whole, the month was exceptionally favorable for picking cotton, and the work was nearly finished, except in the northern portion of the central districts. Recent rains in Texas caused injury to a small part of the crop.

The reports indicated a good apple crop, except in the Ohio and central Mississippi valleys and portions of the Middle Atlantic States.

While considerable rotting of potatoes was reported from portions of New England and the Middle Atlantic States, a fine crop was generally indicated, the least favorable reports being received from the Ohio Valley, where the crop was only fair.

November.

As a whole, November was a very mild and exceptionally dry month. Throughout the central valleys and New England and in the Middle Atlantic and central and west Gulf States, the absence of rain was so marked as to prove injurious to fall-sown grain and to hinder plowing. The drought was especially severe in the Ohio Valley, where there was a great scarcity of water for stock and domestic purposes. Complaints of drought were also received from southern California and the southern Plateau districts.

In the principal corn States the weather was favorable for husking and cribbing corn, the reports indicating that this crop was of exceptionally fine quality.

Winter wheat was unfavorably affected by drought over the greater part of the winter-wheat belt, the condition of the crop being least favorable in the Ohio, central Mississippi, and lower Missouri valleys. Considerable damage to the early sown by the Hessian fly was also reported from Nebraska and Missouri. Notwithstanding the drought, the general condition of the crop in Kansas, Iowa, and Illinois was good. Favorable reports were also received from parts of the Atlantic coast districts, where, however, lack of moisture retarded growth.

In the Southern States the weather conditions were favorable for the completion of cotton picking.

Average daily temperature departures (degrees Fahrenheit) for season of 1904 from normal, based upon observations for many years, by sections.

Sections.	From Jan. 1 to Apr. 4, inclusive.	For weeks ended— April— 11.	April— 18.	April— 25.	May— 2.	May— 9.	May— 16.	May— 23.	May— 30.	June— 6.	June— 13.	June— 20.	June— 27.
New England	−4.3	+4.9	− 5.1	− 5.2	−0.1	+4.9	+1.5	+1.0	+5.4	−1.2	−5.1	−3.8	+2.8
Middle Atlantic States	−4.4	+3.4	− 5.7	− 6.1	−0.3	+2.2	+0.5	−0.8	+5.3	+1.2	−2.3	−3.5	+1.1
South Atlantic States	−2.0	−1.2	− 3.1	− 5.7	−2.5	−1.1	−2.2	−0.8	+2.8	+2.2	−2.2	−4.5	−0.6
Florida Peninsula	+0.4	0.0	0.0	+ 1.0	−3.0	+0.7	+1.0	−0.7	+0.3	+1.3	−0.7	−1.7	−2.0
Eastern Gulf States	+0.1	−4.0	− 4.9	− 1.0	−6.9	+0.8	−4.8	−2.8	+2.2	+1.8	−0.9	−1.2	+0.8
Western Gulf States	+2.4	−5.6	− 3.3	+ 2.6	−4.6	−0.7	−4.3	−0.4	+1.6	+2.4	−1.0	−1.3	−1.3
Ohio Valley and Tennessee	−2.2	−4.0	−10.9	− 4.7	−6.1	+4.2	−5.3	−3.1	+3.9	+1.9	−4.1	−1.8	+0.5
Lower Lake region	−4.7	+2.4	−10.6	− 4.9	−3.8	+9.9	−1.1	−2.0	+4.4	+0.6	−3.4	−1.6	+0.2
Upper Lake region	−4.8	+0.3	−10.1	− 5.2	+1.6	+7.6	−4.7	+3.1	+1.0	−1.6	−1.4	−1.8	−1.5
North Dakota	−3.4	−2.7	−10.0	−10.0	+9.0	+5.0	−5.3	+3.3	−3.7	−2.0	−2.3	+1.3	−3.7
Upper Mississippi Valley	−3.0	−3.8	−11.6	− 3.6	−1.0	+4.8	−4.6	+0.2	−0.7	0.0	−2.6	−2.2	−2.3
Missouri Valley	+0.5	−4.9	− 9.9	− 7.5	+0.1	+3.3	−2.7	+1.7	−2.1	−2.0	−2.5	−0.5	−3.1
Northern slope	+1.5	+1.0	− 0.4	− 1.9	+4.1	−0.1	−1.1	+3.9	−3.7	−2.6	−2.4	+2.0	−4.1
Middle slope	+3.4	+3.7	− 4.8	+ 1.7	−2.5	−1.7	−2.3	+1.3	−1.7	−1.8	−2.7	−1.0	−5.2
Southern slope	+5.4	−3.0	− 1.5	+ 5.5	−1.0	0.0	−2.5	+1.0	−1.5	+2.0	−1.5	−0.5	−3.5
Southern plateau	+2.2	+3.8	+ 7.2	− 3.4	−3.8	−0.2	+3.4	+2.2	−0.7	0.0	+0.5	+1.2	−3.0
Middle plateau	+5.2	+1.0	+ 7.8	− 6.0	−3.5	−2.8	+3.2	+3.8	−1.0	−2.0	−0.8	+3.2	−3.0
Northern plateau	+3.3	+1.8	+ 9.8	− 3.2	−0.2	−3.2	−0.6	+3.6	−1.2	−1.2	−3.6	+6.0	+3.4
North Pacific coast region	−0.4	+3.3	+ 9.1	− 1.3	−0.9	−3.3	+0.7	+0.4	−0.3	−0.1	−2.7	−0.4	−3.0
Middle Pacific coast region	−0.8	+8.5	+ 5.8	− 5.8	−5.2	+3.0	+5.0	+3.8	+1.0	+1.2	+4.5	−1.0	0.0
South Pacific coast region	+0.7	+8.5	+ 3.0	− 5.2	−4.8	+0.5	+2.5	+1.5	+0.2	+2.0	+3.8	+1.0	−1.0

Average daily temperature departures (degrees Fahrenheit) for season of 1904 from normal, based upon observations for many years, by sections—Cont'd.

Sections.	For weeks ended—													
	July—				August—					September—				October—
	4.	11.	18.	25.	1.	8.	15.	22.	29.	5.	12.	19.	26.	3.
New England	−3.2	−0.2	+0.2	−0.8	+1.0	0.0	−3.6	−0.2	−1.2	+0.2	−3.2	+0.6	−4.6	− 0.6
Middle Atlantic States	−2.6	+0.2	−1.0	−0.2	−1.2	+0.8	−1.7	+0.4	−2.6	+1.6	−2.0	−0.2	−2.8	+ 4.5
South Atlantic States	0.0	+1.6	−1.1	−0.5	−2.6	−1.9	−0.6	+1.9	−0.7	+1.9	−1.7	−0.1	−1.1	+ 6.5
Florida Peninsula	−0.7	0.0	−1.7	−1.7	−1.7	−1.0	−1.3	0.0	−0.7	+0.7	−0.3	0.0	0.0	+ 0.7
Eastern Gulf States	−0.5	−2.1	−1.4	−2.4	−3.1	−1.6	−2.1	+1.1	+0.2	+0.6	+0.5	+1.8	+3.8	+10.0
Western Gulf States	−2.0	−1.4	0.0	−3.0	−2.4	−1.4	−2.4	+1.0	+0.9	+2.1	+0.3	+0.3	+4.4	+ 8.4
Ohio Valley and Tennessee	−5.2	−0.4	−1.1	−1.2	−2.2	−0.7	−1.5	+1.1	−1.7	+1.9	+0.8	−1.5	+0.9	+ 7.0
Lower Lake region	−5.2	−0.5	+0.2	−0.4	−0.9	−1.1	−3.4	+0.1	−1.9	−0.5	−0.9	−1.4	−3.5	+ 1.6
Upper Lake region	−5.0	−3.4	+1.7	−1.4	−0.6	−3.4	−2.0	−1.4	−1.0	−3.7	−1.3	−2.3	−3.8	+ 2.9
North Dakota	−3.7	−3.0	+2.0	−2.0	−4.0	−2.3	+2.3	−3.0	−0.3	−2.3	+1.7	−6.3	−2.7	+ 7.7
Upper Mississippi Valley	−6.4	−4.5	+0.3	−3.2	−1.9	−3.9	−2.3	−0.2	−3.0	−0.8	+0.1	−2.7	+0.4	+ 7.8
Missouri Valley	−5.5	−5.7	+1.1	−3.9	−1.3	−4.2	+0.2	−0.3	+0.3	−1.4	+0.2	−3.1	+1.1	+ 7.6
Northern slope	−1.7	−3.1	+0.1	−1.0	−1.9	−0.9	+3.3	−1.9	+0.9	−0.6	+4.6	−1.9	+1.6	+ 6.7
Middle slope	−3.3	−2.8	+2.0	−3.0	−1.0	−2.8	+0.7	−1.2	+1.3	+1.0	+0.8	−1.0	+3.0	+ 7.3
Southern slope	−3.0	0.0	+1.0	−4.0	+0.5	−2.5	−0.5	+3.0	+3.0	+2.5	−2.0	−0.5	+2.5	+ 9.5
Southern plateau	−2.0	−1.7	−1.0	−2.0	−2.0	−1.5	0.0	+0.3	−0.5	0.0	+0.2	−0.7	−1.2	− 1.2
Middle plateau	−0.4	−2.4	−4.0	+1.4	−1.2	+1.8	+2.0	−1.6	+0.4	0.0	+5.6	+3.4	−0.6	− 1.6
Northern plateau	+2.6	+4.8	−6.6	+0.4	−2.6	+6.0	+4.4	−1.0	+1.8	+0.2	+6.2	+4.0	+1.8	+ 4.6
North Pacific coast region	+2.4	+1.4	−5.7	+1.9	+0.7	+2.1	−0.4	−1.0	−2.0	+0.4	+1.7	+0.6	0.0	+ 3.4
Middle Pacific coast region	−1.8	−3.2	−3.2	+2.2	0.0	−0.5	−0.5	+1.0	−1.0	+1.8	+3.8	0.0	−3.0	+ 3.0
South Pacific coast region	−2.0	−2.2	−3.0	+1.8	+0.5	+1.0	+2.2	+1.5	+2.0	+4.0	+8.5	+2.8	−1.8	+ 0.8

Precipitation departures (inches and hundredths) for the season of 1904 from normal, based upon observations for many years, by sections.

Sections.	From Jan. 1 to Apr. 4, inclusive.	For weeks ended—											
		April—			May—					June—			
		11.	18.	25.	2.	9.	16.	23.	30.	6.	13.	20.	27.
New England	−1.81	+0.50	0.00	−0.21	+1.78	−0.61	+0.50	+0.13	−0.52	+0.05	−0.11	−0.67	−0.33
Middle Atlantic States	−3.49	−0.20	−0.64	−0.75	−0.02	−0.70	+0.20	−0.37	−0.67	+0.78	+0.56	−0.57	−0.56
South Atlantic States	−3.16	−0.56	−0.37	−0.69	−0.41	−0.22	−0.58	−0.42	−0.78	−0.30	+0.30	−1.09	−0.81
Florida Peninsula	−0.38	+0.72	−0.48	−0.13	+0.39	+0.82	−0.42	+2.82	−0.93	−0.25	+0.87	−0.51	−0.39
Eastern Gulf States	−6.71	+0.19	−1.04	−0.94	−0.50	−0.20	−0.82	−0.38	−0.52	−0.28	−0.33	−1.21	−0.73
Western Gulf States	−5.16	+0.19	−0.82	+1.12	+0.20	+1.26	−0.69	−0.83	−0.01	+0.70	−0.37	−0.73	+1.01
Ohio Valley and Tennessee	−1.71	−0.43	−0.69	−0.27	−0.02	−0.37	−0.53	−0.39	+0.20	+0.43	−0.55	−0.39	−0.23
Lower Lake region	+3.05	−0.05	+0.05	+0.01	−0.14	−0.65	+0.01	−0.18	−0.21	+0.18	−0.58	−0.48	−0.32
Upper Lake region	−0.21	+0.29	−0.06	−0.01	−0.51	+0.65	−0.20	+0.09	+0.11	−0.09	−0.69	−0.73	−0.25
North Dakota	+0.67	+1.06	−0.44	+0.15	−0.44	+0.07	−0.10	−0.44	−0.47	+1.16	+0.15	−0.81	−0.33
Upper Mississippi Valley	−0.25	+0.24	−0.60	+0.96	−0.40	+0.15	−0.56	−0.42	+0.13	+0.45	−1.00	−0.45	−0.21
Missouri Valley	−1.07	+0.29	−0.67	+1.79	−0.73	+0.39	+0.06	−0.59	+0.68	+0.83	−0.75	−0.18	+0.30
Northern slope	−0.21	−0.28	−0.37	−0.02	−0.09	+0.79	−0.41	+0.31	+0.16	+1.14	+0.08	−0.39	−0.28
Middle slope	−1.38	−0.11	−0.49	+0.85	−0.46	+1.02	−0.30	−0.62	+0.30	+2.15	+0.17	−0.06	+1.14
Southern slope	−1.56	−0.32	−0.50	−0.56	−0.68	−0.38	−0.28	−0.07	+0.06	+0.72	−0.72	−0.68	+2.65
Southern plateau	−1.11	−0.06	−0.05	−0.07	−0.08	−0.07	−0.04	−0.02	−0.02	−0.07	0.00	−0.04	+0.19
Middle plateau	+1.52	−0.16	−0.23	+0.25	−0.15	+0.29	−0.22	−0.22	+0.38	−0.09	−0.09	−0.11	−0.07
Northern plateau	+1.17	−0.26	−0.05	+0.58	−0.19	−0.30	−0.28	−0.14	−0.33	+0.34	−0.29	−0.26	−0.25
North Pacific coast region	+4.37	−0.30	−0.48	−0.05	−0.47	−0.26	−0.55	−0.16	−0.56	−0.09	−0.27	+0.05	−0.39
Middle Pacific coast region	+6.47	−0.68	−0.19	+0.59	+0.48	−0.42	−0.26	−0.04	−0.23	−0.03	−0.15	−0.11	−0.07
South Pacific coast region	−0.42	−0.38	−0.28	+0.49	+0.41	−0.11	−0.08	−0.07	−0.03	−0.05	−0.04	0.00	0.00

Precipitation departures (inches and hundredths) for the season of 1904 from normal, based upon observations for many years, by sections—Continued.

Sections.	For weeks ended—													
	July—				August—					September—				October—
	4.	11.	18.	25.	1.	8.	15.	22.	29.	5.	12.	19.	26.	3.
New England	+0.39	-0.40	-0.36	-0.21	-0.42	+0.37	+0.13	+1.10	-0.77	-0.63	-0.44	+1.57	-0.28	+0.04
Middle Atlantic States	+0.25	+0.21	-0.10	+0.30	-0.42	+0.49	-0.10	-0.26	-0.71	-0.47	-0.77	+1.26	-0.71	-0.58
South Atlantic States	+0.38	-0.09	-0.77	+0.46	+0.31	+0.91	-0.25	-0.83	0.11	-0.62	-0.15	-0.58	-0.56	-0.97
Florida Peninsula	-0.63	-0.90	-0.27	-0.76	+0.14	-0.50	+1.16	-0.88	-0.58	-0.26	-0.21	-1.20	-0.77	-1.89
Eastern Gulf States	+0.01	+0.29	+0.16	-0.14	+0.29	+1.37	+0.18	-0.76	+0.54	-0.08	-0.70	-0.88	-0.01	-0.70
Western Gulf States	+0.14	+0.27	-0.58	+0.37	-0.37	+0.15	-0.14	-0.78	-0.42	-0.43	-0.05	+1.09	-0.19	-0.61
Ohio Valley and Tennessee	+0.02	+0.26	-0.49	-0.35	-0.43	-0.13	-0.12	-0.11	-0.11	-0.34	-0.63	-0.28	+0.62	-0.50
Lower Lake region	+0.40	+1.16	-0.21	-0.14	-0.28	-0.49	-0.02	+0.85	-0.31	+0.13	-0.37	-0.27	+0.12	-0.32
Upper Lake region	+0.15	-0.20	-0.08	-0.34	+0.16	-0.36	-0.08	+0.96	-0.49	+0.26	-0.50	-0.22	+0.06	-0.36
North Dakota	-0.42	-0.56	+0.48	-0.02	-0.31	-0.47	-0.43	-0.16	-0.28	+0.80	-0.33	0.00	+0.38	-0.01
Upper Mississippi Valley	-0.43	+0.51	-0.32	-0.12	+0.20	-0.44	+0.34	+1.09	-0.23	+0.04	-0.56	+0.69	-0.31	-0.20
Missouri Valley	-0.31	+0.89	-0.59	+0.09	-0.35	-0.28	-0.09	+1.86	-0.46	-0.10	-0.42	+0.14	-0.20	+0.34
Northern slope	-0.09	+0.40	-0.09	-0.11	-0.24	-0.16	-0.22	-0.04	+0.10	+0.18	-0.22	-0.21	+0.23	+0.23
Middle slope	-0.17	+0.91	-0.35	-0.32	-0.27	-0.02	-0.46	+0.80	-0.35	-0.10	+0.01	-0.30	+0.23	+0.48
Southern slope	+0.58	-0.58	-0.54	+0.94	-0.52	+0.12	-0.43	-1.60	-0.55	+0.48	-0.60	-0.48	+0.56	+0.44
Southern plateau	-0.11	-0.25	-0.30	+0.17	+0.30	+0.10	+0.04	+0.49	+0.24	+0.32	+0.12	+0.11	+0.16	+0.56
Middle plateau	-0.03	+0.03	-0.07	+0.03	+0.12	-0.02	+0.16	-0.06	+0.18	-0.06	-0.12	+0.29	+0.13	-0.02
Northern plateau	+0.04	+0.08	+0.08	-0.06	+0.02	+0.03	+0.03	-0.06	+0.07	-0.11	-0.15	-0.18	+0.06	-0.16
North Pacific coast region	-0.33	-0.23	+0.64	-0.16	-0.05	-0.14	-0.14	-0.20	-0.05	-0.42	-0.50	-0.72	-0.61	-0.54
Middle Pacific coast region	-0.01	+0.03	+0.17	0.00	0.00	0.00	0.00	-0.01	+0.02	-0.06	-0.10	-0.16	+3.51	-0.25
South Pacific coast region	0.00	0.00	0.00	0.00	0.00	-0.02	+0.02	0.00	+0.02	0.00	0.00	-0.02	+1.24	+0.04

LEGISLATION ON DISEASES OF DOMESTIC ANIMALS.

By D. E. Salmon, D. V. M., *Chief of Bureau of Animal Industry.*

Few of the State legislatures meet during the even-numbered years, and in 1904 only five enacted laws upon contagious diseases of domestic animals. These were for the most part of minor importance, the only amendment of any extent being to that part of the Rhode Island law of 1892 which deals more particularly with tuberculosis and glanders and farcy.

Iowa.—An act approved April 12, 1904, amends the law previously in force relating to the appropriation for carrying on the work of the State veterinary surgeon in eradicating contagious diseases of domestic animals. The amount appropriated for this purpose is increased from $5,000 to $7,500.

Maryland.—An act approved April 7, 1904, authorizes the commission appointed in 1902 to investigate cerebro-spinal meningitis of horses to continue its labor until January, 1906. The usual funds under the law of 1902 are to be available for use. The commission is to report the results of its investigations to the governor not later than January 1, 1906.

New York.—An act approved April 8, 1904, amends the existing law relative to the State appraisers of condemned animals. The new law authorizes the commissioner of agriculture to appoint one appraiser, in lieu of three as formerly. The former appraisers received $5 per diem, with expenses for time actually employed. The new appraiser is to receive $1,500 per annum and necessary expenses. Authority is also given to the commissioner to appoint such additional appraisers from time to time (at $5 per diem and expenses) as the necessities of the work may demand.

Rhode Island.—An act passed April 8, 1904, to amend section 10 of chapter 99 of the General Laws (passed May 19, 1892), provides that animals suspected of being tuberculous shall be officially examined, and if found to be diseased shall, after appraisal, be killed and the carcasses properly disposed of. The State is to pay one-half of the appraised value of the animals if diseased; but if they are found not to be affected with tuberculosis the State shall pay the full value, provided the animals have been owned in the State for at least three months. Animals suffering or suspected to be suffering from glanders, farcy, or any other contagious disease shall likewise be killed and their carcasses disposed of. All appraisals shall be made by the veterinarian and one cattle commissioner of the county where the animal is located. The maximum allowance for any single animal shall be: For a native animal, $50; for a grade, $75; for a registered animal, $100. Right of appeal from the award of the appraisers is given within five days.

The board of appraisers is empowered to quarantine any animals supposed to be suffering from any contagious disease, one-third of the expense of which is to be paid by the State, except as provided in section 30 of the law.

The inspectors of the Bureau of Animal Industry, in cooperation with the State authorities, are empowered to enter premises for the purpose of inspection, and are also authorized to call upon peace officers to assist them in the discharge of their duties.

Virginia.—The original law of 1887, amended in 1890 and 1896, relating to the disposal of hogs and fowls that have died of contagious diseases is amended so as to include all animals and grown fowls. The new law, which was approved March 15, 1904, provides that all such animals and fowls which have died from any contagious or infectious disease shall be cremated or buried. If this is not done by the owner any justice may, after giving notice thereof, order the work done, and be entitled to recover from the owner $5 for every animal and $1 for every fowl so disposed of.

PLANT DISEASES IN 1904.

By W. A. Orton, *Plant Pathologist, Bureau of Plant Industry.*

This résumé of plant diseases in 1904 is compiled from reports of field observations by agents of this Department and officers of the several State experiment stations, whose cooperation is gratefully acknowledged. It indicates briefly the prevalence of such diseases in the United States in 1904, as compared with conditions in previous years, which are recorded in the six preceding Yearbooks.

The influence of weather conditions upon epidemics of diseases caused by plant parasites has been as usual quite marked, especially in the case of the destructive outbreak of rust in cereals, and the relative absence of downy mildews on account of drought in the Southern and Eastern States.

The injury due to winter-killing has been of extraordinary proportions in New England, New York, Michigan, and adjacent States. Native species like white pine, white ash, red and sugar maples, birches, and poplars showed the effects. Fruit trees were greatly injured; in unfavorable situations and where enfeebled by age or disease, orchards were practically destroyed. Large numbers of peaches were killed outright, and others had the branches killed back, while the fruit buds were mostly destroyed. Apples, pears, and other fruits and many ornamental plants were also killed or injured in many cases. The aggregate loss from this cause was of great proportions.

POME FRUITS.

Apple.—Bitter rot (*Glomerella rufomaculans*) caused relatively slight losses, because of the short apple crop and favorable weather conditions in the sections usually affected. The range reported extended from Polk and Haralson counties in northwest Georgia through western North Carolina and Virginia into portions of West Virginia, southeast Ohio, Indiana, Kentucky, Missouri, Oklahoma, and Arkansas. The first authentic report of rot in Connecticut was received. Black rot or canker (*Sphæropsis malorum*) was reported injurious only in Ohio and West Virginia. It occurs throughout the Allegheny and eastern apple sections. Illinois canker (*Nummularia discreta*) was common in the Central and Western States. Diseases of this character do not vary greatly in severity from year to year. Blackspot canker (*Gloeosporium malicorticis*) prevailed in the Pacific coast section. W. H. Lawrence, of the Washington station, has published an account of the disease, reporting the successful use of Bordeaux mixture in combating it.

Blight (*Bacillus amylovorus*) was injurious to apples in many sections. It seems not to have been especially bad in the South, but received mention from West Virginia, Kentucky, New Jersey, Pennsylvania, Ohio, Indiana, North Dakota, and Nebraska as more than usually abundant. In Colorado and Pacific Coast States it continues to be the most destructive disease. Apple orchardists there are adjusting themselves to the conditions by planting resistant varieties and removing pear trees.

Crown gall continues to be a great pest in nurseries, especially in the central portion of the country, but there are indications of an improved condition over previous years.

Fruit spot (*Phoma pomorum*) has been common in the South, particularly in the apple districts of North Carolina, South Carolina, and north Georgia.

A new fruit rot caused by an *Alternaria* is reported from Colorado by W. W. Paddock.

Powdery mildew was reported frequent on nursery trees in Arkansas, but less abundant than last year. In the moister regions of California the young spring growth suffered severely.

Rosette, a disease due to uncongenial soil, poor water supply, and winter injury, appears in certain localities in Colorado each year.

Rust (*Gymnosporangium* spp.) appears to have been more abundant than usual in the Eastern States and as far west as Nebraska. In Iowa it was the most destructive enemy to certain varieties, especially Wealthy.

Scab (*Venturia inæqualis*) was more abundant than usual in the eastern United States and was destructive on unsprayed trees. Iowa reports damage to susceptible varieties only, while in Nebraska the loss amounted in some cases to 90 per cent. There was much less scab in California this year.

Pear.—Black rot (*Sphæropsis malorum*) affected seriously both fruit and foliage in Ohio. No other reports.

Blight (*Bacillus amylovorus*) was unusually prevalent. In Georgia, Florida, and other Southern States moist, warm weather following the blooming period led to a development of blight that reduced the crop one-half. The loss in Maryland was estimated at 15 per cent, and at points in Indiana from 10 to 75 per cent. New Jersey, Ohio, Illinois, Iowa, and Nebraska report much damage. In Colorado great loss continues to be caused by it. On the eastern slope of the mountains it has destroyed practically all the pear trees, while on the western slope it is of more recent introduction, but threatens the industry. In California the disease has practically wiped out the pear industry of the San Joaquin Valley and this year brought a remarkable extension of it into the Sacramento Valley 200 miles north of previous records. The situation there is very serious.

Leaf blight (*Entomosporium maculatum*) was reported injurious on European seedling pears in Kentucky, and did much damage in orchards in Georgia and other Southern States, where early defoliation from leaf blight led to much fall blooming, and thus favored the spread of the bacterial blight. The estimated loss in Maryland was 7 per cent.

Scab (*Venturia pyrina*) was common in California, where it is increasing in the northern and eastern part of the Sacramento Valley. R. E. Smith, of the California

Station, has demonstrated that in that State, just as in the Eastern States, to control this disease it is essential to spray once or twice while the fruit buds are opening in spring.

Sooty mold (*Fumago vagans*), following psylla and aphis, was not noticed in New England, where it was so common last year.

Quince.—Black rot (*Sphæropsis malorum*) was injurious in Ohio. Blight (*Bacillus amylovorus*) was unusually abundant on this host also.

STONE FRUITS.

This group, including almonds, apricots, cherries, peaches, plums, and prunes, is subject to several general diseases.

Crown gall is very prevalent in nurseries throughout the country, causing losses as high as 25 per cent, especially in the Southern and Central States. In California loss is greatest on almonds, peaches, and prunes.

Brown rot (*Sclerotinia fructigena*) varied in severity according to the weather in different sections. The main peach crop of middle Georgia was nearly free from rot. There was much greater loss in north Georgia, amounting to 15 per cent of the crop. In Maryland plums suffered most, the loss on varieties like Wickson and Abundance being 30 to 100 per cent, while early peaches were a complete loss and midseason varieties rotted badly. In the Northern States the disease occurred about as usual where the crop had not been destroyed by winter injury. There was little in Michigan. In the Central States and Kentucky plums suffered severely. In California early apricots and plums were injured more than usual.

Root rot, or "toadstool disease," due to different species of fleshy fungi, is reported to be increasing in California, especially on prunes and apples, also affecting other fruits.

Cherry.—Leaf spot (*Cylindrosporium padi*) caused an estimated loss of 8 per cent in Maryland, being worst on sweet cherries. West Virginia, Missouri, Kentucky, Ohio, and Nebraska also report loss. Scab (*Fusicladium cerasi*), a new spot disease, was discovered in Ohio.

Peach.—Leaf curl (*Exoascus deformans*) occurred about as usual, but spraying is every year practiced more generally, with uniform success. Little peach has extended over a wider area in Michigan and New York, but the percentage of injury has been greatly reduced by the cutting-out method practiced under the directions of this Department. Scab (*Cladosporium carpophilum*) was unusually abundant in New York, but less so in Ohio. Split pit in California was very common and caused serious loss. It was also reported on almonds. Yellows has increased in Maryland, New York, and Michigan, but more active measures are now taken to combat the disease.

SMALL FRUITS, CITRUS FRUITS, ETC.

Blackberry.—Crown gall on both canes and underground portions was very abundant in Colorado and Washington. Rust (*Gymnoconia interstitialis*) was reported to be common and destructive in New York and abundant in Colorado and California.

Citrus fruits.—Wither tip (*Colletotrichum gloeosporioides*) prevailed in Florida to a decidedly increased extent, owing to the peculiar climatic conditions when the fruit was maturing. The aggregate loss probably amounted to $150,000.

Cranberry.—Anthracnose, blast, rot, and scald occurred about as heretofore. The loss was greatest in New Jersey, about 20 per cent less in the Cape Cod region, and very small in Wisconsin. Noteworthy success was attained in the spraying experiments conducted by the Department.

Grape.—Anthracnose (*Sphaceloma ampelinum*) was prevalent and serious in the Lake Erie grape region and reported bad in Oklahoma. Black rot (*Guignardia Bidwellii*) was apparently much less serious than last year, except possibly in New York. The loss in Rhode Island and Maryland is estimated at 20 per cent. Downy mildew (*Plasmopara viticola*) was more abundant in New York and Pennsylvania, but less injurious in Iowa and other States. Powdery mildew (*Uncinula necator*) was common at the end of the season in Connecticut and injurious to fruit of thin-skinned varieties. Damage was also reported from Nebraska.

Olive.—Dry rot was much worse in California than ever before, causing serious loss in many instances.

Orange.—"Puffy orange" was the most serious trouble in California, though various other diseases were of general occurrence.

Pineapple.—Wilt is becoming more severe among the smooth Cayenne plantations in Florida.

Raspberry.—Anthracnose (*Gloeosporium venetum*) is the cause of complaint in Kentucky, Iowa, and Nebraska, where it is increasingly destructive. The extent of injury in Saunders County, Nebr., was 33 per cent. Crown gall was reported from Arkansas, Kansas, Nebraska, Missouri, Iowa, and California, where considerable injury seems to have been done by it. Rust (*Gymnoconia interstitialis*) is especially mentioned only in Indiana, where it did much damage in the southern counties.

Strawberry.—Leaf spot (*Sphaerella fragariae*) was less common in Kentucky. In Maryland, the only other State reporting, the injury was 21 per cent.

FIELD AND GARDEN VEGETABLES AND TOBACCO.

Asparagus.—Rust (*Puccinia asparagi*) was somewhat more pronounced in the Eastern States than in 1903; estimated loss in Maryland, 21 per cent. It continues to be very destructive in North Dakota, eastern Nebraska, and other Western States. Successful treatment is reported by the California station.

Bean.—Anthracnose (*Colletotrichum lindemuthianum*) was destructive in New York, but probably not so much so as in 1903. Bacteriosis (*Bacillus phaseoli*) was also general in New York. This and anthracnose have led many growers to adopt spraying, and have discouraged others from planting beans. Downy mildew (*Phytophthora phaseoli*) was reported from New Jersey. Rust (*Uromyces appendiculatus*) was reported from Nebraska, North Carolina, and West Virginia.

Beet.—Curly-top of sugar beets was reported from California and Utah as of slight occurrence in comparison with previous years. Leaf blight (*Cercospora beticola*) was as usual more or less noticeable in the Eastern States, though not as injurious as in previous years. Rust (*Uromyces betae.*) occurred in a scattering manner in California, particularly in the winter.

Cabbage.—Black rot (*Pseudomonas campestris*) has been of general occurrence in the Eastern, Central, and Southern States, but has aroused much less complaint than in previous years. H. A. Harding and F. C. Stewart at the New York State Station have shown that the germs of this disease are carried on the seed, where their vitality may be retained for several months.

Cantaloupe.—Anthracnose and downy mildew did but little harm this season. Leaf blight (*Alternaria brassicae nigrescens*) was present in the Eastern and Southern States, but caused less damage than usual. It was, however, unusually destructive in the Rocky Ford district in Colorado. Wilt (*Bacillus tracheiphilus*) was very injurious in New York and also caused much complaint in the Central States.

Celery.—Leaf blight (*Cercospora apii* and *Septoria petroselini apii*), both occurred in Ohio and other States. Serious injury was not reported.

Cucumber.—Anthracnose (*Colletotrichum lagenarium*) was of relatively minor importance this year. Downy mildew (*Plasmopara cubensis*) occurred to a limited extent in Florida. Owing to the unusually dry spring it did not reach South Carolina until the cucumber crop was nearly harvested, about July 1, so no great loss was caused. Sprayed fields remained healthy after others had been killed. This and other diseases of vine crops were rarer in New England than for several years. In Kentucky and Ohio also the disease appeared late and did little harm. Wilt (*Bacillus tracheiphilus*) was general and destructive in New York.

Ginseng.—Leaf blight (*Alternaria*) was very general and destructive in many places in New York. Root knot, due to nematodes, occurred in Rhinebeck, N. Y. Soft rot was very destructive in Fulton County, N. Y. J. M. Van Hook has published studies of these and other ginseng diseases from the Cornell Station.

Lettuce.—Drop (*Sclerotinia libertiana*) was destructive in Florida and the Atlantic coast trucking regions.

Melon.—See Cantaloupe and Watermelon.

Onion.—Downy mildew (*Peronospora schleideniana*) again occurred quite generally in New York, and to some extent in the seed-growing fields in California. Smut (*Urocystis cepulae*) was as common as usual in Connecticut, but aroused less complaint in Ohio than in previous years. Stem rot (*Botrytis vulgaris?*) was notably absent in Connecticut, but the severity of its attacks in 1902 and 1903 cut down the acreage of the susceptible variety—Southport White Globe.

Pea.—Leaf spot (*Ascochyta pisi*) occurred on field peas in the Chillicothe, Ohio, district as reported last year. Powdery mildew (*Erysiphe polygoni*) was reported from New York, from Nebraska, where it caused 33 per cent loss to late crops in Lancaster County, and from southern California. Root rot (*Rhizoctonia*) attacked sweet peas in New York. In Colorado it is abundant every year, but only occasionally does serious damage. The injury this year was slight and mainly in causing too early maturity.

Potato.—Brown rot (*Bacillus solanacearum*) occurred in scattered localities from Maryland south without causing great loss. Dry rot (*Fusarium oxysporum*) contributed to the general loss. It seems to be most prevalent in the Central and Southern States and west to California, where it is common but not of much importance.

Early blight (*Alternaria solani*) was reported abundant in Massachusetts, but not especially harmful in New York and other States. Late blight (*Phytophthora infestans*) appeared unusually late in New England and occasioned less blighting of the foliage than usual, but the resulting rot of the tubers caused very great losses. In New York late blight was very destructive. F. C. Stewart, at the Geneva Station, increased the yield of marketable tubers 233 bushels per acre by spraying, and demonstrated that the average loss throughout the State was over 60 bushels per acre. In Ohio the disease prevailed to a greater extent than for ten years, especially in the northeastern portion. Michigan, Wisconsin, and Minnesota also suffered, but Iowa was free from the trouble this year. Scattered outbreaks occurred in Florida on the early crop.

Rhizoctonia (*Corticium vagans solani*) occurred quite generally in the East from Connecticut south, causing some injury in South Carolina. In Ohio much complaint was heard, and in Colorado it was more abundant than usual in all sections, and appears to be indigenous to the soil. Scab (*Oospora scabies*) appears to have been unusually abundant throughout the country.

Squash.—Wilt (*Bacillus tracheiphilus*) was more or less abundant in Colorado.

Sweet potato.—Rot (*Fusarium*) was common and destructive in Merced County, Cal.

Tobacco.—Bed rot (*Rhizoctonia*) was reported from Ohio. Broom-rape (*Orobanche ramosa*) occurred in Claremont County, Ohio. Mosaic disease seems to have been less prevalent this year.

Tomato.—Blight (*Bacillus solanacearum*) has occurred as usual in scattered cases throughout the Southern States and as far north as Maryland. A similar trouble is reported from eastern Colorado. Leaf mold (*Alternaria solani*) did marked injury for the first time to fruit and leaves of tomatoes in Ohio. Leaf spot (*Septoria lycopersici*) caused some loss in the Eastern States and west to Nebraska. The loss in Maryland is estimated at 19 per cent. Point rot was mentioned from North Carolina and South Carolina, and another rot, probably *Colletotrichum*, caused much injury in Kentucky, Indiana, Missouri, and Nebraska, the loss in some cases approaching 90 per cent. Western blight, a disease mentioned in several previous Yearbook reports, was abundant in western Colorado, Idaho, and neighboring States. The cause is unknown. Wilt (*Fusarium*) did very little damage in Florida this year.

Watermelon.—Anthracnose (*Colletotrichum lagenarium*) was injurious in South Carolina, West Virginia, and elsewhere. Leaf blight (*Cercospora citrullina*) was reported from West Virginia. Leaf mold (*Alternaria brassicae nigrescens*) was found on watermelons in Colorado. Wilt (*Neocosmospora vasinfecta nivea*) continues to spread in the South and has also been found in Oklahoma, California, and Oregon.

CEREALS AND FORAGE CROPS.

Barley.—Rust was reported from some localities, but the crop suffered no considerable loss. Smut (*Ustilago hordei*) was prevalent in California.

Corn.—Leaf blight (*Helminthosporium inconspicuum*) was again prevalent in New Jersey and adjacent States, and was reported from Ohio. Smut (*Ustilago zeae*) was common throughout the corn-growing region, as usual. In Connecticut and Ohio and possibly other States it appeared to be more plentiful, while in Kentucky and Indiana it was less common.

Oats.—Rust (*Puccinia graminis*, etc.) was destructive in Ohio, Iowa, Nebraska, and especially so in the Northwestern States. Indiana, northeastern Iowa, and Montana report less injury. Smut (*Ustilago avenae*) was less destructive than usual.

Rice.—Blast, a new fungus disease, caused much loss in South Carolina again this year. Various diseases have begun to appear in the Texas and Louisiana rice belt.

Sorghum.—Burrill's bacterial disease occurred around Washington, D. C.

Wheat.—Rust (*Puccinia graminis*) this year, 1904, caused very general damage over the whole country, due to the humidity of the atmosphere in the latter part of the growing season, and to lateness of the grain in maturing. In the spring-wheat States of the Northwest the loss from rust was 25,000,000 to 40,000,000 bushels, worth at least $25,000,000. In many instances the rusted fields were never touched by the harvester, and over wide areas the yield was only 4 to 5 bushels per acre. The western winter-wheat States also suffered severely, and rust was bad as far east as Indiana and Ohio, though not severe in Maryland. The durum varieties introduced by the Department proved notably resistant, though the season brought out great variations in rust

resistance even in this group. M. A. Carleton, of this Department, has published further results of investigations into the life history of this and several other species of rust. Scab (*Fusarium culmorum*) was much worse than usual in Maryland. The loss is estimated at 15 per cent. Unusual injury was reported from Ohio, Iowa, Nebraska, Kansas, and Missouri. The smuts were not more prevalent than usual.

Alfalfa.—Leaf-spot (*Pseudopeziza medicaginis*) was general in New York and Ohio. Root rot in Texas and the Southwest has done much damage. Rust (*Uromyces striatus*) was reported from eastern Nebraska and southern California.

Cowpea.—Root knot (*Heterodera radicicola*) was common in sandy soils in the South Atlantic and Gulf States. Wilt (*Neocosmospora vasinfecta tracheiphila*) is becoming more extended where cowpeas are grown several years on the same land.

FIBER PLANTS.

Cotton.—Anthracnose (*Colletotrichum gossypii*) was general throughout the South, but injurious only in scattered cases, where it caused much rotting of the bolls. Root knot (*Heterodera radicicola*) was common in sandy soils, particularly in the Gulf States. Root rot in Texas was worse than usual this year. Wilt (*Neocosmospora vasinfecta*) continues to spread, but was not as active last season as usual.

Flax.—Rust (*Melampsora lini*) was generally destructive to early flax in North Dakota. Wilt (*Fusarium lini*) is becoming more generally distributed in North Dakota, but the destruction was less this year, owing to seed treatment and avoidance of old fields.

NUTS, FOREST TREES, AND SHADE TREES.

Catalpa.—Heart rot was reported to be destructive in southeastern Nebraska. Leaf spot (*Phyllosticta catalpae*) caused serious injury in Ohio.

Cedar.—Rust (*Gymnosporangium macropus*) was reported to be causing much injury to red cedars in Iowa and Nebraska.

Cottonwood.—Blight, due to soil troubles or frost, was reported quite generally in North Dakota. Rust (*Melampsora populina*) was less destructive this year.

Pecan.—Rosette is common and injurious in South Carolina, Georgia, Florida, and Alabama. Scab (*Fusicladium effusum*) was less injurious than last year, but injured the crop in some places in Georgia and other States.

Walnut.—Blight (*Pseudomonas juglandis*) was much less abundant in southern California than in 1903, although more prevalent than ever before in the northern part of the State.

GREENHOUSE AND ORNAMENTAL PLANTS.

Aster.—Yellows appears to be as prevalent in California as in the Eastern States.

Calla Lily.—Soft rot, a disease that has been injurious for several years, has been thoroughly investigated by Dr. C. O. Townsend, of this Department, who has shown that the cause is *Bacillus aroideae*, n. sp.

Iris.—Leaf blight (*Heterosporium gracile*) was very bad and quite general; reported from Connecticut and California.

PROGRESS OF FRUIT GROWING IN 1904.

By W. H. RAGAN, *Expert in Pomological Nomenclature, Bureau of Plant Industry.*

The best pears imported into England were formerly grown mostly in France. In 1904 the United States sent a large supply to that market. This is doubtless due to improved methods of handling, refrigeration, and transportation. Also, the largest exportation of apples from the United States and Canada to the United Kingdom in any one year was during the fiscal year 1904. The total exports for that year from these sources aggregated 3,127,000 barrels.

The Consolidated Grape Growers' Association of New York, representing the product of 50,000 or 60,000 acres of the State's choicest soils now devoted to that industry, made a most interesting and successful exhibit at the Louisiana Purchase Exposition, at St. Louis. On October 4, 1,229 plates, including 71 varieties, were displayed. This and other displays at the exposition furnished an object lesson of far-reaching value as an illustration of the rapid strides now being made in the development of fruit growing. No intelligent visitor, not blinded by prejudice, could fail to recognize the reward, already clearly manifested, that the fruit grower of the present day is receiving as the result of modern methods in the production of varieties, in culture, in handling, and in the artistic arrangement of exhibits, etc.

Perhaps no more important work is now being done in the interest of commercial fruit growing by the office of Pomological Investigations than through its investigations in the line of cold storage and refrigeration of fruits. These investigations have been going forward for several years, and references to them have appeared from year to year. A number of valuable facts have already been given out, and additional tests are made and reported as rapidly as is consistent with careful experimentation. During the past year one of the tests made has developed the fact that fruit from young and rapidly growing trees on rich soil breaks down earlier in storage warehouses than does the fruit of the same varieties when grown on older and more mature trees. This is especially true of certain leading commercial varieties, as York Imperial, Hubbardston, Winesap, Ben Davis, Rhode Island, etc. It has also been proved that varieties of this class scald in the barrel less when allowed to remain on the trees until well matured and highly colored. And again, fruit that is roughly handled and bruised will not keep in cold storage, no matter what the other conditions may be, equal to that which is handled carefully. It is safe to estimate that three-fourths of the trouble in keeping fruit in cold storage arises from careless and bad handling.

A writer on fruits in referring to the immensity of the Georgia peach crop, incidentally mentions the manner of its handling and the facilities afforded for that purpose. During the past season one railroad furnished more than 4,000 cars with which to move the Georgia crop to northern markets. "The peaches are taken from the trees during the hot months of the summer and are very warm when they reach the hands of the packers. They are put in boxes while still warm and are placed in refrigerator cars, which have been stationed on sidings near the orchards. These cars are all kept at as near the right temperature required by the peaches as possible, and as soon as they are loaded they are started on their journey north. They are not sent in the manner of ordinary freight trains, but are run in trains of ten and fifteen cars, and at a very high rate of speed. Even the regular passenger trains are sidetracked to allow fruit trains to pass. Regular passenger engines are used. The trains leave Atlanta after midnight and reach Alexandria in twenty-four hours. There they are iced again, taken in hand by the Pennsylvania road, and run into Jersey City. Regular passenger-train speed is maintained during all the long run. The run from Georgia to New York City is made in the best time that roads are capable of, and the peaches are on the market in New York at midnight of the third day from that on which they were gathered from the trees."

There is perhaps no other interest for which the railroads could be induced to subordinate their passenger traffic. The method of handling, as above described, will doubtless be somewhat changed in the near future. Careful experiments conducted under the auspices of the Pomologist, during the last season, clearly proved the desirability of cooling the fruit before packing in the refrigerator cars for transportation. This was accomplished by placing it in stationary cold-storage warehouses for some hours before loading.

GRASSES AND FORAGE PLANTS.

By W. J. Spillman, *Agrostologist, Bureau of Plant Industry.*

ALFALFA IN THE EASTERN STATES.

Interest in the alfalfa crop in the eastern half of the United States has been growing rapidly for the past five years, and is more marked at present than at any time in the past. The demand for seed continues to exceed the supply, and the 50 per cent increase in price of seed which occurred some years ago has been maintained. It has been demonstrated that on dairy farms alfalfa may largely replace grain feed. Several instances are reported in which dairy cows have been fed on alfalfa, either in the green state or cured into hay, without other feed, with fairly satisfactory results. It seems therefore that this hay crop, which is essentially new to the eastern half of the United States, will greatly decrease the cost of production of dairy products. The recognition of this fact is at the basis of the present successful effort to grow this crop in the Eastern States. The value of alfalfa as a pasture for hogs is gaining recognition, and the crop is much used for this purpose.

CASSAVA, PARA GRASS, AND GUINEA GRASS.

Interest in the cassava crop continues. Extensive investigations are in progress with a view to working out the main difficulties in the cultivation and utilization of cassava, and throughout the Gulf coast country farmers are experimenting with the crop.

Para grass and Guinea grass are gaining ground in southern Texas and in Florida, where suitable forage crops have hitherto been wanting, with the exception of alfalfa in southern Texas. For wet soils Para grass has shown itself to be an excellent forage plant both for pasture and for hay production, while Guinea grass has proved to be a good pasture plant for moderately dry soils. These are both tropical grasses, having been introduced from the West India Islands, but they have shown themselves capable of withstanding the climate of northern Florida, and farmers even farther north than this are experimenting with these grasses.

MILO MAIZE.

During the past year it has become known that the plant grown in Oklahoma and northwestern Texas under the name of milo maize is a variety of nonsaccharine sorghum eminently adapted to semiarid regions. It has shown itself to be the most reliable crop in the Panhandle country, and its cultivation as a grain crop, and also as a fodder crop, in that section is rapidly increasing. This crop has frequently made 30 bushels of grain per acre without rain after the crop was planted, provided the soil was fairly well supplied with moisture at planting time. Farmers all over the arid and semiarid sections of the United States are experimenting with it. It seems to be a variety of brown durra, and the name dwarf milo has been suggested for it.

CLOVER SICKNESS.

For the past six or eight years there has been increasing difficulty in securing a satisfactory stand of clover throughout the clover region. This is an old trouble in England, where the difficulty is ascribed to some mysterious malady which has been given the name of clover sickness. The cause of the trouble is unknown. It has recently been suggested by an English investigator that it is due to a fungus disease which attacks the clover plant, and there is considerable circumstantial evidence favoring this hypothesis. The common method of sowing clover is to sow it on slightly frozen ground in early spring where wheat and timothy were sown the previous fall. When sown in this manner the clover does not make a crop the first year, and is largely killed out during the succeeding winter, presumably by the fungus growth. The destruction of the crop is practically completed during the second winter. A number of the best farmers in the northeastern section of the United States have learned that by sowing clover and timothy together the latter part of August, without a nurse crop, a good stand is practically assured and a full crop is harvested the next summer. A fair crop is secured the second year. It has been suggested that sowing clover in August prevents infection from the fungus the first season and thus enables the clover to make a full crop the next year. The method of sowing clover in August is gaining favor among progressive farmers, at least from Ohio eastward.

FORAGE PLANTS IN DIVERSIFIED FARMING.

One of the most important movements of recent years is the progress toward diversified farming in the cotton-producing States. The spread of the cotton-boll weevil has emphasized the importance of crops other than cotton, and the area devoted to grasses and forage plants is rapidly increasing throughout the cotton belt.

The principal forage crops of which the area is increasing to a marked degree are alfalfa, corn, cowpeas, and sorghum. For the past two or three years the demand for cowpea seed has been greater than the supply. Bermuda is also growing in favor as a pasture plant throughout the South in spite of its weedy tendencies.

PROGRESS OF FORESTRY IN 1904.

By Quincy R. Craft, *Editorial Clerk, Bureau of Forestry.*

The year 1904 saw a large gain in the popular acceptance and application of the principles which govern the proper care and use of woodlands. Many landowners and great lumber concerns now realize that conservative forest management means actual gains to them in dollars and cents; and western stockmen and miners no longer doubt that regulation of grazing and cutting timber on the reserves is necessary for the perpetuation of their industries. Forest work carried on by the Federal Government in conjunction with the States was rich in results. State forest departments

were created, better forest laws enacted, and many object lessons given of the opportunities to maintain and extend the forests within the various Commonwealths. The Bureau of Forestry surpassed any previous year in the variety and extent of its investigations and experiments, in the knowledge gained of actual conditions and needs in the reserve regions of the West, and in the preparation and installation of working plans upon forest lands.

The remarkable advance of forestry during recent years was fittingly marked by a forest congress extending through four days of the first week in January, 1905. This meeting far exceeded in size and importance any similar gathering that has been held in America. The lumbering, mining, grazing, and woodworking industries, the railroads, and the interests of irrigation in the West were represented by men of the highest professional and business standing and of national reputation. In conference with these men were the official representatives of many States and of the Canadian and Philippine forest services.

FOREST RESERVE POLICY MORE CLEARLY UNDERSTOOD.

Careful consideration of the needs of the industries which use the products of the forest reserves, and of the requirements necessary to preserve the public forests permanently, is leading to a national policy concerning the Federal forest reserves. The prime purpose in establishing these reserves is to prevent fires, wasteful lumbering, and overgrazing, and at the same time to secure the fullest possible use of their productive capacity. Often their most important service is to guard the forested mountains and hillsides from which the streams flow, for water is the first need of the arid States; but the interests of the miners, who can not operate without heavy supplies of timber, and of the stockmen dependent upon the public range, must also be recognized.

In 1904 seven new forest reserves were created—Baker City, in Oregon; Cave Hills and Slim Buttes, in South Dakota; Grantsville and Salt Lake, in Utah; and Warner Mountains and Modoc, in California. Additions were made to the Fish Lake (Utah), the South Platte (Colorado), and the Big Horn (Wyoming) reserves. Several areas, having a total of 1,054,342 acres, which examination had shown to be better suited for agriculture than for forestry, were restored to the public domain, so that the net increase in the area of the reserves was but 149,035 acres.

Changes in boundaries during 1904 and present area of Federal forest reserves.

States and Territories.	Number of forest reserves.	Area of reserves created in 1904.	Area added in 1904.	Lands unsuited eliminated in 1904.	Area of reserves, Dec. 31, 1904.
		Acres.	*Acres.*	*Acres.*	*Acres.*
Alaska	2				4,909,880
Arizona	8				6,740,410
California	10	594,736		320	9,427,154
Colorado	6		3,681	237,182	2,874,439
Idaho	[a] 3			57,600	3,989,480
Montana	[b] 7		45,440	127,360	7,964,640
Nebraska	2				208,902
New Mexico	3				3,257,920
Oklahoma	1				57,120
Oregon	4	52,480			4,637,560
Porto Rico	1				65,950
South Dakota	[c] 3	81,520			1,244,840
Utah	8	164,400	131,200		2,756,280
Washington	[a] 4				7,024,760
Wyoming	[d] 4		129,920	631,880	8,199,624
Total	[e] 62	893,136	310,241	1,054,342	63,358,959

[a] The Priest River Reserve is situated jointly in Idaho (541,160 acres) and Washington (103,960 acres).
[b] The Bitter Root Reserve is situated jointly in Montana (621,200 acres) and Idaho (3,398,400 acres).
[c] The Black Hills Reserve is situated jointly in South Dakota (1,163,320 acres) and Wyoming (46,440 acres).
[d] The Yellowstone Reserve is situated jointly in Wyoming (6,580,920 acres) and Montana (1,229,680 acres).
[e] Four of the reserves are enumerated twice (see *a*, *b*, *c*, and *d*), so that the total number is 62.

A GAIN OF SIGNIFICANT IMPORTANCE.

It is an achievement of no small moment that the public generally has been led to regard forestry as something tangible and helpful. The adoption of forest management is now regarded as vitally necessary for the continuance of the manifold industries for which forest products are essential, and for the supply of many needs of everyday life. The desire of many landowners to secure for their forest holdings the best care is indicated by the numerous inquiries and requests for assistance received by the Bureau of Forestry. Applications for assistance are now on file covering an area of no less than 8,000,000 acres, for three-fourths of which preliminary examinations have been made. Detailed working plans have been completed for over 1,000,000 acres of these lands. Twenty thousand acres in woodlots and 500,000 acres in timber tracts are under management. That working plans are now in preparation for an area aggregating 3,500,000 acres shows how fast this work is growing. Private enterprises are beginning to take advantage of the examples furnished by the Government, and are employing trained foresters to carry out their own plans of management.

LARGE OPPORTUNITIES IN THE SOUTH.

The possibilities of forest management on the forest lands in the South have been clearly shown in several large working plans recently finished and put into practice by the owners. There the cheapness of labor and favorable natural conditions permit more careful logging methods and more complete utilization of material than are possible in certain other sections, and the longer growing season and the relative nearness to markets offer peculiar advantages for conservative lumbering with a view to future crops. The interest of northern and eastern lumbermen is turning more and more to the hardwoods found in that region. The diversity of species that compose those hardwood forests, and the increasing utility of many of them, together with the rapid increase in their value, are leading their owners to inquire about the means of removing material that is now marketable, without destroying that which may be valuable in the future. Nowhere is the opportunity for conservative forest management more promising than in some parts of that great region.

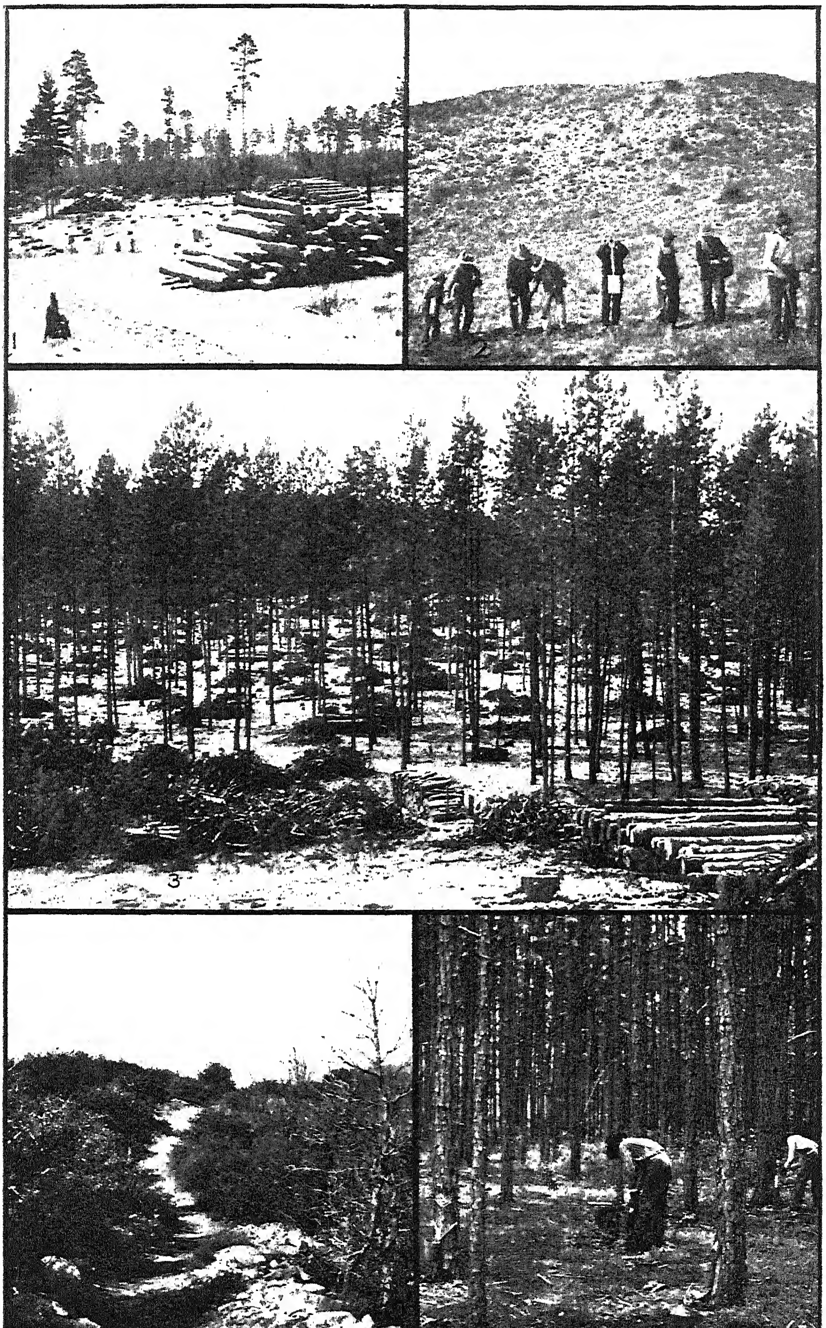
AN EXAMPLE IN THE LUMBERING OF WHITE AND RED PINE.

The success that has attended the sale and removal of timber from the Chippewa Indian lands in northern Minnesota, selected to constitute the Minnesota National Forest Reserve, has done much to establish the practicability of conservative lumbering of white and red pine in that region. Although the timber is to be removed under regulations prescribed by the Forester of the Department of Agriculture, and although 5 per cent of the timber on the area to be lumbered is reserved to provide for reproduction (Pl. LXXV, fig. 1), the stumpage price obtained at public sale was the largest that had ever been realized for similar timber in the same region. When the present utterly waste condition of vast areas in the Lake States formerly covered with valuable pine forests is considered, the demonstrated possibility that such timber can be cut and removed profitably, under restrictions intended to secure forest renewal and reduce the danger from fire to the minimum, is one of large hopefulness.

SOME PRACTICAL INVESTIGATIONS OF THE BUREAU OF FORESTRY.

The new system of turpentining, by the use of cups and gutters, which gives a greatly increased product of turpentine and uniformly higher grades of rosin, with far less damage to the trees, fulfills its early promise of increased profits and extended life for the naval stores industry (Pl. LXXV, fig. 5). In consequence, the destructive method of boxing trees for turpentine has been abandoned by the larger and more progressive operators, while the improved method of turpentining has extended rapidly during the year. As a further service the Bureau now has in progress an entirely new line of field experiments which look to a very considerable lessening of the tapping wound now made in the trees.

The condition of the basket willow industry has been studied, and several exceedingly important plans for its improvement are outlined in a bulletin. These improvements will secure the highest grades of home-grown willow through more scientific methods of culture. A study of the maple-sugar industry has resulted in the publication of a bulletin containing suggestions which are important to the farmers of the Northeastern United States. An exhaustive investigation has been conducted to determine the present available supply of Pacific coast tanbarks, and the best method of collecting the bark, while encouraging the reproduction of the trees on cut-over areas and providing for a more economical utilization of the timber.



CHARACTERISTIC SCENES IN ECONOMIC FORESTRY.

FIG. 1.—Seed trees left uninjured by logging and the burning of slash, Minnesota National Forest Reserve. FIG. 2.—Forest planting in the sandhills, Nebraska. FIG. 3.—The woodlot under forest management, South Dakota. FIG. 4.—A mountain trail which has stopped the progress of a fire, California. FIG. 5.—Application of the new system of cups and gutters in turpentining, Georgia.

A series of regional studies is furnishing a fuller knowledge of forest conditions and possibilities over large areas. This knowledge will enable the Bureau to answer an increased number of requests for assistance by sending the required information in printed form or by correspondence, instead of making a special examination on the ground in each case. Studies of the rate of growth, market conditions, and general characteristics of eight principal commercial trees of the Southern Appalachians, and of the available quantity and quality of timber which they furnish, have just been completed. Examinations of planted groves have been made in northern Illinois, in eastern Nebraska, and in the eastern part of the Dakotas and western Minnesota, and the data collected made available for future recommendations for forest planting in those regions. Investigations have also been conducted in California to determine the relation of chaparral to water supply and forest reproduction.

Tests of the mechanical and physical properties of various timbers were carried on at Berkeley, Cal., Lafayette, Ind., New Haven, Conn., St. Louis, Mo., and Washington, D. C. At these stations the strength of red fir, western hemlock, red gum, longleaf pine, and loblolly pine have been under investigation, sticks of the ordinary market grades being selected for the tests. Defects, such as knots, crooked grain, and checks, and the important facts with reference to the growth of the timber, are carefully noted. After the tests on the large pieces have been made, a small number of pieces are cut from the uninjured portions of the log and tested in the same manner. This enables a comparison to be made between the strength of the small clear pieces and the large sticks, and shows the weakening effect of unavoidable defects in the larger pieces. A series of tests is also being conducted to determine the mechanical properties of the various hardwoods which are now used or are probably available for use in the manufacture of vehicles. A study of the strength of second-growth red oak, for instance, has shown its high value as a substitute for white oak. Studies of various products, such as telephone cross-arms and pins, boxboards, etc., are in progress, and are expected to show how to economize material and to correct defects of practice.

FORESTRY PROVES HELPFUL TO THE RAILROADS.

Transportation companies are showing keen interest in the search for methods to prolong the life of ties and other timbers, which, if successful, will contribute to the conservation of forest resources. Several railroads are making extensive experiments with wooden tie-plates to lessen the wear of the tie under the rail. Two railroads of the Northwest have found it economical to carefully season their lodgepole pine ties, and are experimenting with seasoned western hemlock and red fir ties. Several western roads are using chemically preserved ties.

During the year 1904 the Bureau of Forestry established several new seasoning stations in different parts of the country, and investigations are now being conducted on twenty different kinds of wood. New methods of handling and treating timber have also been studied, and in several instances the large economies have led to the commercial use of the methods employed. Particular attention has been paid to determining the effect of treatment with various preservatives upon the strength of timber. One of the results is that the preliminary steaming usually practiced is found to reduce the strength of timber materially, and that water solutions, such as zinc chlorid and mercuric chlorid or corrosive sublimate, reduce the strength of timber to about the same extent as would an equal amount of water. Timber treated with such preservatives regains strength, however, upon drying out, whereas timber treated with creosote does not, because creosote remains in the wood in liquid form.

FOREST METHODS OF DISTINCT ADVANTAGE TO FARMERS.

Fence posts of cottonwood, ash, maple, and other perishable woods may be made to last 15, 20, and even 25 years by treating their butts with tar oil. This method of preservation has been investigated during the past year at St. Louis, and in cooperation with the Bureau of Forestry the farmers in the vicinity of Las Vegas, N. Mex., will treat a large number of posts for pasture fences in this way. Since fence posts are a necessity on every farm and ranch, this means of using timbers quickly grown but naturally subject to early decay will effect a great economy in regions where wood is scarce. The equipment has been simplified until the installation of a plant is a practicable undertaking for individuals or for a small community. The cost of materials does not exceed 5 to 7 cents for each post treated.

In the Eastern States particularly the farmers have shown interest in a more careful management of their woodlots. That this interest is rapidly spreading is evidenced by the fact that 80 applications for assistance were received from Ohio and 53 from Michigan. Over 40 woodlots were examined in Ohio during the past field season, and 25 in Michigan. (See Pl. LXXV, fig. 3.)

SYSTEMATIC METHODS IN FOREST PLANTING.

The assistance of the Bureau of Forestry has been extended as heretofore to many people desiring to establish permanent forest plantations. The service rendered becomes more and more effective as knowledge is acquired of the adaptability of various trees to the conditions of soil and climate in various localities, and of the most successful methods of propagating, transplanting, and cultivating trees.

Several States also have been encouraging forest extension by planting on their reservations. New York has established a plantation of deciduous trees at Canoe Point, on the St. Lawrence River, and has prepared to set out several hundred thousand spruce seedlings the coming spring. During the past two years Pennsylvania has been planting white pine in open places on its reservations. In the Michigan forest reserve 40 acres of cut-over land were planted with 50,000 pines and spruces. Minnesota has raised a large number of young spruce trees with a view to planting 1,000 acres of reserve land if a State appropriation for this purpose can be secured.

On the Federal forest reserves tree planting is rapidly passing the experimental stage. On the Dismal River Forest Reserve, in Nebraska, the total cost of foresting sandhill country with pines (Pl. LXXV, fig. 2) has been reduced to $3.68 per acre. In southern California the work of reserve planting has been continued, and preliminary operations have been begun on the Pikes Peak Reserve in Colorado.

Various private interests likewise are turning to forest planting as a means of insuring a supply of wood to meet their necessities. A notable instance of this is offered by the Pennsylvania Railroad, which continues the planting of locust trees in Pennsylvania, 223,000 having been set out during the year. The chief engineer of maintenance of way estimates that it would require the planting of 1,300,000 trees each year to supply the annual needs of the road for ties, anticipating that the first crop will be harvested after thirty years. This example will stimulate the cultivation of tie timber by other landowners convenient to the railroads.

FOREST FIRES.

The number and destructiveness of forest fires during the past year were not so great as in 1903. Well-distributed rainfall accounts largely for this difference, but it is nevertheless conspicuous that nearly all the States which employ forest officers or maintain fire wardens escaped severe fires. Numerous fires started in those States, but they were extinguished before they gained great headway. It is to be noted that even throughout the regions of Montana, Idaho, Oregon, and Washington, where the greatest loss was suffered, the forest reserves and the few private holdings upon which fire patrol is attempted escaped with less injury than the totally unprotected forests adjoining. To establish a system of protection against or prevention of forest fires at a reasonable cost, it is necessary to know the causes of fires. Based upon the principle of closely watching the exposed points, effective work with economy of effort has been done the past summer in northern Maine, in the town of Plymouth in Massachusetts, in the region about South Mountain in Pennsylvania, and in the Sierras of California. The success attained by the Mount Pocono (Pennsylvania) Fire Protective Association emphasizes the advantage of thorough organization, and the importance of retaining patrolmen at a small salary to look out for fires throughout the year and of paying them promptly. In several States the prospects of effective control of the fires, upon which the future of American forestry so largely depends, is more promising than at any time in the past. (Pl. LXXV, fig. 4.)

FORESTRY AND FOREST LEGISLATION IN THE STATES.

New State forestry associations were formed in Iowa, Ohio, and Vermont. The activity in forest legislation shown by the States was apparently less in 1904 than in 1903, because only a few States held legislative sessions. Of these, Massachusetts passed a law providing for a technically trained State forester to care for the forest interests of the State. New York, heeding her disastrous lesson through forest fires in 1903, provided for a patrol to prevent future fire devastation. This law is a notable advance in two respects: It is a definite attempt to substitute preventive for remedial measures, and it requires railroads, the principal source of forest fire danger in the State reserves, to pay one-half the cost of a patrol along their lines. Louisiana passed a forest law providing for the care of wooded land in that State. There are now 11 States which have some form of forest administration, and the Bureau of Forestry has been called upon frequently to furnish advice with regard to proposed forest laws. This demand has been met by the publication of a bulletin containing a complete compilation of Federal and State forest laws, and by the preparation, in cooperation with State officials, of no less than 15 State forest bills to be submitted to the legislatures at their next sessions.

FOREST SCHOOLS.

The courses at the Yale Forest School, the Biltmore Forest School, the University of Michigan Forest School, and the Harvard University Forest School have been strengthened by the inclusion of new studies and the employment of additional instructors. Increased attendance gives evidence of prosperity at each institution.

EXHIBIT AT THE LOUISIANA PURCHASE EXPOSITION.

As a part of its educational work the Bureau of Forestry made an extensive exhibit at the Louisiana Purchase Exposition, St. Louis, Mo., of the forest conditions and problems found in all parts of the country and of the methods of Government work. Type forests and forest conditions of the East and the West, and scenes also of the treeless Middle West, were vividly portrayed by numerous large photographic transparencies and colored prints, uniquely arranged for comparison. The practical applications of forestry were features of this display. A wood-preserving plant and a timber-testing station were in practical operation. The new system of turpentining by cups and gutters, promoted by the Bureau, was contrasted with the old destructive method of boxing the trees, by means of a group of longleaf pine trunks. Out of doors a 3-acre tract of land was devoted to showing approved methods of raising forest trees from seed, and how forest plantations should be established in different parts of the country. The keenest interest was manifested in all these exhibits by the many visitors at the Exposition, and there is little doubt that the Bureau accomplished a good work by thus bringing forestry to the attention of so many people.

FOOD LEGISLATION AND INSPECTION.

By W. D. BIGELOW, *Chief, Division of Foods, Bureau of Chemistry.*

Relatively little was accomplished in the way of food legislation by the last meeting of the legislatures of the various States. No general food laws were enacted and but few new laws of even limited scope. The amendments to the existing laws were not sufficiently numerous or important to call for extended notice.

In meetings of those interested in pure-food legislation from a manufacturing standpoint and of those engaged in the administration of food laws, the necessity of uniformity in the legislation of the various States has been emphasized even more strongly than during previous years. A Federal bill, which it was thought might lead to such uniformity and which is regarded by some as a necessary step in that direction, passed the House of Representatives, but did not come to a vote in the Senate at the session of Congress which closed March 4, 1905.

EVIDENCES OF PROGRESS.

In general the food laws enacted during 1904 showed progress in several directions. In Kentucky a more liberal appropriation was made, thus making it possible to extend the work. The amount given the experiment station was increased one-half and the annual expenditures permitted were increased from $7,500 to $10,500. In Ohio the salary of the dairy and food commissioner was increased from $2,000 to $3,500. One of the great obstacles in the way of the proper enforcement of the food laws has been the limited compensation of those engaged in such enforcement. A step in the direction of correcting this evil can therefore result only in good.

The same State also provided for the appointment of an additional assistant commissioner, thus further broadening the work of the commission. A slight advance was also made in Iowa, where an additional assistant commissioner was appointed, and the salaries of the deputy commissioner and assistant commissioner were advanced from $1,000 to $1,200. In New Jersey the municipal boards of health are empowered to designate as inspectors of food and drugs one or more of their local sanitary inspectors.

Considering the limited amount of food legislation during the year just passed, the laws enacted for the purpose of improving sanitary and hygienic conditions are of some importance. For instance, in New Jersey a law has been enacted, similar to those enforced in a number of other States, forbidding the keeping of milk cows in unwholesome places and requiring their proper feeding. The same State has required that cans used for the transportation of milk shall be properly cleansed.

Serious poisoning cases resulting from the use of methyl alcohol in place of ethyl alcohol have also led to the enactment of laws forbidding this practice. It is probable that the majority of States in which efficient food laws are now in force will not find it necessary to enact such laws, as such a substitution is found to be in violation of practically all the food laws that are now in force.

CHANGES IN EXISTING LAWS.

Some of the changes in legislation during the year, as is usually the case, had for their purpose the improvement of the character of the goods on the market. This is true of the enactment in Ohio which requires all cheese containing less than 30 per cent of fat to be labeled as skimmed cheese. In this State the standard was formerly 20 per cent. In this connection may be mentioned the amendment to the maple-sugar law in the same State, and the law in Maryland making the requirements for standard vinegar similar to those of a number of other States.

In several cases the legislation enacted during the year extended to some extent the provisions of the law to articles which had not before been included. For instance, in New York the law prohibiting the sale of adulterated milk was so amended as to include the adulteration of cream, and the law regulating the sale of certified milk was amended in such a manner as to make it more effective without in any way changing its purpose.

There has been for some time a feeling that the standards for milk enforced in several States requiring a different amount of solids for different seasons of the year were based on incorrect information. Recent studies of the subject have led to the belief that the same milk standards might be enforced for the entire year, and it has been suggested that existing laws might be changed in that manner. Legislation of this nature was enacted in Ohio, which will probably be followed later in several other States.

STATISTICS OF INSPECTION.

The information in the following table was gathered from State and municipal food law officials, so far as they could be reached. The inspectors whose work is reported are usually men of good judgment and considerable experience in selecting food samples and only foods suspected were sampled; also only such samples were analyzed as seemed likely to show violations of law. Accordingly the table does not show the ratio of adulterated foods to pure foods on the American market. The whole great mass of high-grade foods is excluded from any calculation that may be made upon the figures here given.

The Denver, Colo., data are for six months in 1904; District of Columbia and Michigan, for year ended June 30, 1904; Boston, year ended February 1, 1905; Worcester, Mass., eight months ended November 30, 1904; New Hampshire State, complete to October 1, 1904; Rhode Island, for year ended July 30, 1904, and Virginia, year ended March 1, 1905.

In Connecticut the law requires notification of retail dealers as to the character of goods before prosecution. Upon notification the dealers withdraw the goods, so prosecutions are few. In Kansas information regarding examinations was published in the newspapers, but there were no prosecutions. In New Hampshire desired results have been obtained without resort to the courts. At Altoona, Pa., city health officers merely assist the State food department.

In the District of Columbia, 237 samples examined were water, of which 55 proved unsanitary; in Denver, Colo., 3,407 of the samples examined were cream, of which 10 were below standard; at Cambridge, Mass., 10 milk samples were colored and 2 contained preservatives; at Detroit, of the samples below standard, 8, all from one source, contained formaldehyde. Since the convictions noted no formaldehyde has been found.

In Indiana the Fort Wayne milk samples were low in butter fats and watered. The Indianapolis prosecutions brought $360 in fines, with costs. At Cleveland, Ohio, samples below standard are exclusive of water samples.

In Massachusetts, the food samples at Cambridge were butter and vinegar; at Fitchburg and Holyoke, vinegar; at Lynn, decayed fruits.

In New Jersey, 8,827 examinations of meat, with 4 prosecutions, 3 convictions, and 1 case pending, are not included, and the Rochester, N. Y., milk samples do not include 557 bacterial counts.

The Alabama conviction was for unsanitary conditions at dairy.

Statistics of food examinations and prosecutions under laws, 1904.

State and city.	Samples examined.		Samples below standard.		Prosecutions.		Convictions.		Cases still pending.		Organization or officer charged with enforcing law.
	Milk.	Other foods.	Milk.	Other foods.	Milk.	Other foods.	Milk.	Other foods.	Milk.	Other foods.	
Alabama—Montgomery	358	0	0	0	1	0	1	0	0	0	Sanitary department.
Arkansas—Little Rock	90	...	5	...	5	...	5	...	0	...	Board of health.
California:											
Los Angeles	1,071	346	6	89	5	11	5	10	0	0	Health department.
Sacramento	903	...	4	...	1	...	...	...	1	...	Board of health.
San Francisco	2,009	609	197	188	73	20	20	0	15	0	Department of public health.
Colorado:											
State inspection	...	116	...	76	...	23	...	12	...	6	Dairy commissioner.
Denver	7,309	...	31	...	16	...	14	...	...	...	Board of health.
Pueblo	571	...	1	29,320	1	...	1	...	...	...	Health department.
Connecticut:											
State inspection	496	1,322	38	250	...	15	...	15	...	...	Agricultural experiment station and dairy commissioner.
Hartford	243	...	16	...	0	...	0	...	0	...	Milk inspector.
Delaware—Wilmington	280	...	16	...	16	...	16	...	0	...	Do.
District of Columbia	7,969	517	2,378	111	323	43	309	307	...	...	Health officer.
Georgia—Atlanta	1,200	20	10	4	10	...	10	...	...	...	Board of health.
Hawaii—Territorial inspection	1,168	112	100	33	4	0	3	0	0	0	Do.
Illinois:											
State inspection	302	1,414	59	507	35	215	3	99	32	116	State food commission.
Chicago	25,243	1,576	1,847	243	1,370	64	1,303	64	51	0	Department of health.
Rockford	300-400	...	10	...	2	...	2	...	...	...	Health department.
Indiana:											
State inspection	0	191	0	90	0	0	0	0	0	0	State board of health.
Fort Wayne	431	0	22	...	1	...	1	...	0	...	Department of public health.
Indianapolis	735	221	171	41	20	9	20	8	...	1	Board of health.
Iowa—State inspection	70	...	[a] 8	...	0	...	0	...	0	...	State dairy commission.
Kansas—Topeka	50	20	0	6	0	...	...	...	...	...	City board of health.
Kentucky:											
State inspection	300	400	97	187	30	27	1	2	...	...	Food division, experiment station.
Newport	27	...	12	...	0	...	0	...	0	...	Board of health.
Louisiana—New Orleans	4,967	...	80	...	79	...	74	...	5	...	Board of health.
Maryland—Baltimore	365	481	175	216	2	...	2	...	...	...	Health department.
Massachusetts:											
State inspection	270	887	73	95	73	95	73	93	0	0	State dairy bureau.
	4,691	2,799	1,627	278	50	6	48	6	0	0	State board of health.
Boston	16,780	2,066	...	...	297	48	(b)	(b)	0	0	Bureau of milk inspection.
Brockton [c]	82	12	6	6	0	0	0	0	0	0	Board of health.
Cambridge	3,036	124	992	17	7	2	6	1	...	...	Inspector milk and vinegar.

[a] Or more.
[b] Total number of convictions, 320; cases on file, warrants without service, etc., 25.
[c] Board of health makes inspections, but has no authority to prosecute.

Statistics of food examinations and prosecutions under laws, 1904—Continued.

State and city.	Samples examined.		Samples below standard.		Prosecutions.		Convictions.		Cases still pending.		Organization or officer charged with enforcing law.
	Milk.	Other foods.	Milk.	Other foods.	Milk.	Other foods.	Milk.	Other foods.	Milk.	Other foods.	
Massachusetts—Continued.											
Fall River	92	....	0	....	0	....	0	....	0	....	Inspector of milk.
Fitchburg	30	28	8	3	0	0	0	0	0	0	Do.
Holyoke	1,450	165	40	1	2	1	2	1	0	0	Board of health.
Lawrence	286	0	21	0	4	0	4	0	0	0	Milk inspector.
Lowell	2,596	....	4	....	3	....	3	....	2	....	Milk department.
Lynn	1,631	80	3	1	3	1	3	1	0	0	Board of health.
New Bedford	800	....	14	....	....	....	....	....	....	....	Inspector of milk and animals.
Taunton	Few	....	0	....	0	....	....	....	0	....	Milk inspector.
Worcester	765	8	a2	1	2	....	2	....	....	....	Milk inspector.
Michigan:											
State inspection	584	695	52	390	3	7	3	7	0	7	Dairy and food department.
Detroit	1,429	....	8	....	15	....	14	....	....	....	Board of health.
Grand Rapids	2,041	0	4	0	4	0	4	0	0	0	Milk department.
Minnesota—State inspection	701	5,196	101	1,472	5	403	5	400	0	2	Dairy and food department
Missouri—St. Joseph	0	0	12	....	9	....	1	1	1	1	Board of health.
Montana—Butte	600	....	35	....	30	....	....	....	1	....	Health office.
Nebraska:											
State inspection	30	100	....	....	8	....	5	....	....	....	Food department.
Omaha	52	....	1	....	1	....	1	....	0	1	Board of health.
New Hampshire:											
State inspection	371	921	111	412	0	0	0	0	0	0	State board of health.
Manchester	752	....	13	....	0	....	0	....	0	....	Board of health.
New Jersey:											
State inspection	1,624	2,315	268	992	100	21	78	10	15	8	State board of health.
Newark	352	71	63	32	7	11	4	5	2	4	Board of health.
New York:											
State inspection b	150,000	....	131	200	131	200	49	69	82	131	Department of agriculture.
Auburn	572	....	....	....	....	....	....	....	....	....	Board of health.
Rochester	3,902	72	77	5	37	0	30	0	2	0	Health bureau.
Schenectady	61	0	23	....	1	....	1	....	0	....	City attorney.
Syracuse	9,614	....	12	....	4	....	4	....	0	....	Health officer.
Yonkers	748	8	19	....	19	....	4	....	....	....	Board of health.
North Carolina—State inspection	....	347	....	59	0	0	....	....	....	....	Department of agriculture.
North Dakota—State inspection	112	2,200	11	1,087	1	22	1	21	0	0	Experiment station.
Ohio:											
State inspection	1,429	965	302	563	112	20	94	15	6	0	Dairy and food department.
Cincinnati	490	....	10	....	10	....	10	....	0	....	Health department.
Cleveland	7,290	185	10	26	5	0	2	0	0	0	Board of health.
Columbus	681	14	71	3	2	1	2	1	0	0	Health department.
Dayton	45	....	0	....	0	....	0	....	0	....	Do.
Toledo	1,589	96	47	15	....	1	....	1	....	....	Do.

Oregon—State inspection	111	189	32	36	14	5	14	5	0	0	Dairy and food commission.
Pennsylvania:											
State inspection [c]	3,700	3,500	350	1,375	305	1,217	...	...	...	...	Dairy and food commissioner.
Altoona	123	...	5	...	5	...	5	...	...	...	Health officer.
Philadelphia	69,079	...	566	...	20	...	5	...	30	...	Bureau of health.
Reading	200	45	0	12	0	12	0	12	0	0	Market commissioner.
Scranton	2,127	...	...	...	3	...	2	...	...	...	Food inspector.
Williamsport	90	...	10	...	10	10	6	0	4	...	Inspector of State food commission.
Rhode Island:											
Pawtucket	135	...	5	...	5	...	3	...	2	...	Milk inspector.
Providence	7,440	925	264	380	47	1	46	1	...	...	Department of milk inspection.
South Dakota—State inspection	...	237	...	120	0	0	0	0	0	0	Dairy and food department.
Tennessee—Nashville	2,021	27	12	13	12	3	12	3	0	0	City health department.
Utah:											
State inspection	900	450	85	72	24	35	22	34	[d]2	0	Dairy and food department.
Salt Lake City	509	...	0	34,441	0	0	0	0	0	0	Inspector of provisions.
Virginia:											
State inspection	...	214	...	103	...	0	...	0	...	0	Department of agriculture.
Richmond	236	110	40	0	40	0	5	0	35	0	Board of health.
Washington—State inspection	698	351	53	59	10	0	0	0	0	0	Dairy and food commission.
Wisconsin—Milwaukee	{ [e]2,706 6,182 }	21	187	2	9	0	9	...	0	...	Health department.
Wyoming—State inspection	42	446	10	250	...	...	...	...	...	...	Food commissioner.
Total	370,437	33,197	11,073	[f]73,882	3,443	2,559	2,382	1,214	288	277	

[a] Represents court cases only.
[b] The New York State department of health reports that owing to lack of appropriation no systematic work is conducted.
[c] The figures for the Pennsylvania State inspection do not include special investigations. Hundreds of butter and oleomargarine samples subjected to heat tests are also omitted.
[d] Supreme court.
[e] Cream.
[f] This total includes reports of Pueblo, Colo., and Salt Lake City, Utah, of 29,320 and 34,441 samples of vegetables, fruits, etc., below standard; subtracting these figures, the total is 10,121.

AREAS SURVEYED AND MAPPED BY THE BUREAU OF SOILS.

By A. G. RICE, *Chief Clerk, Bureau of Soils.*

The following statement shows the location and extent of soil surveys made up to December 31, 1904. Lithograph maps drawn on a scale of 1 mile to the inch, covering

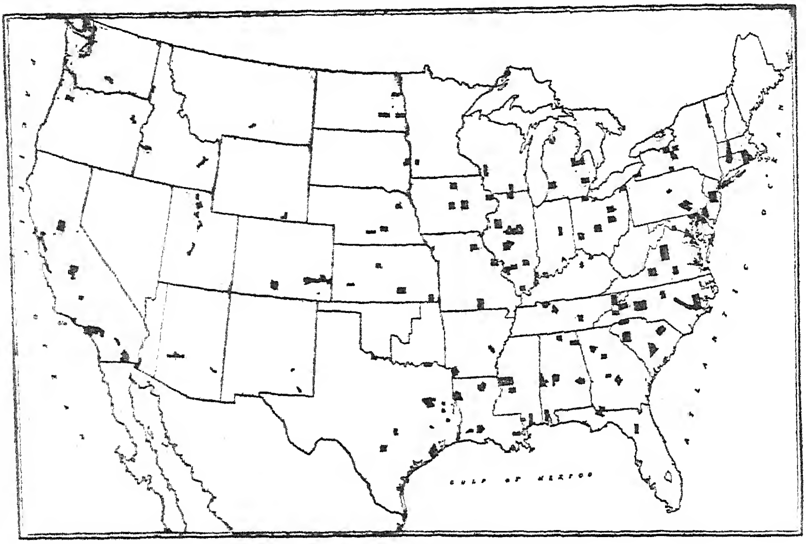


FIG. 64.—Areas covered by the soil survey.

each area surveyed, indicate in colors the distribution of the various soil types. The accompanying sketch map (fig. 64) gives the location of these areas.

The statement gives first the area surveyed for each minor division and then the total for the State or Territory. The total for the United States is 88,858 square miles, or 56,869,120 acres.

Areas of soil surveys in the United States to December 31, 1904.

	Square miles.	
Alabama:		
Blount County	338	
Fort Payne area	509	
Huntsville area	506	
Lauderdale County	315	
Macon County	621	
Mobile area	461	
Montgomery County	338	
Perry County	762	
Sumter County	893	
		4,743
Arizona:		
Buckeye sheet	43	
Phoenix	243	
Solomonsville area	108	
Tempe sheet	163	
Yuma area	343	
		900
Arkansas:		
Miller County	626	
Stuttgart area	251	
		877
California:		
Bakersfield area	195	
Fresno area	628	
Hanford area	216	
Imperial area	1,084	
Indio area	234	
Los Angeles area	570	
Sacramento area	924	
Salinas sheet	189	
San Bernardino area	755	
San Gabriel area	259	
California—Continued.		
San Jose area	313	
Santa Ana area	275	
Soledad sheet	155	
Stockton area	87	
Ventura sheet	240	
		6,124
Colorado:		
Arkansas Valley area	945	
Greeley area	687	
San Luis area	628	
		2,260
Connecticut:		
Connecticut Valley		505
Delaware:		
Dover area		314
Florida:		
Gadsden County	548	
Gainesville area	485	
		1,033
Georgia:		
Bainbridge area	364	
Cobb County	346	
Covington area	225	
Dodge County	489	
Fort Valley area	186	
		1,610
Idaho:		
Boise sheet	155	
Blackfoot area	428	
Caldwell sheet	244	
Lewiston area	308	
		1,135

Areas of soil surveys in the United States to December 31, 1904—Continued.

	Square miles.	
Illinois:		
Clay County	460	
Clinton County	491	
Johnson County	339	
Knox County	717	
McLean County	1,159	
O'Fallon area	68	
Sangamon County	866	
St. Clair County	650	
Tazewell County	645	
Winnebago County	526	
		5,921
Indiana:		
Boonville area	264	
Madison County	435	
Marshall County	445	
Posey County	387	
Scott County	197	
		1,728
Iowa:		
Cerro Gordo County	567	
Dubuque area	440	
Story County	576	
Tama County	720	
		2,303
Kansas:		
Allen County	504	
Brown County	378	
Garden City area	335	
Parsons area	398	
Russell area	270	
Wichita area	465	
		2,350
Kentucky:		
Mason County	225	
Scott County	280	
Union County	361	
Warren County	533	
		1,399
Louisiana:		
Acadia Parish	636	
De Soto Parish	825	
Lake Charles area	202	
New Orleans area	410	
Ouachita Parish	605	
Tangipahoa Parish	228	
		2,906
Maryland:		
Calvert County	217	
Cecil County	376	
Harford County	418	
Kent County	293	
Prince George County	480	
St. Mary County	363	
Worcester County	463	
		2,610
Massachusetts:		
Connecticut Valley		809
Michigan:		
Allegan County	828	
Alma area	282	
Munising area	407	
Owasso area	270	
Pontiac area	307	
Saginaw area	984	
		3,078
Minnesota:		
Marshall area		233
Mississippi:		
Biloxi area	615	
Jackson area	737	
Mayersville sheet	193	
McNeill area	198	
Smedes area	463	
Yazoo sheet	463	
		2,669
Missouri:		
Howell County	919	
O'Fallon area	552	
Saline County	748	
Shelby County	511	
Webster County	605	
		3,335
Montana:		
Billings area		107

	Square miles.	
Nebraska:		
Grand Island area	446	
Kearney area	792	
Stanton area	323	
		1,561
New Jersey:		
Salem area	493	
Trenton area	810	
		1,303
New Mexico:		
Carlsbad sheet	80	
Roswell sheet	49	
		129
New York:		
Auburn area	461	
Bigflats area	223	
Dryden area	315	
Long Island area	845	
Lyons area	515	
Syracuse area	416	
Vergennes area	160	
Westfield area	260	
		3,195
North Carolina:		
Alamance County	365	
Asheville area	497	
Cary sheet	63	
Clayton sheet	214	
Craven area	897	
Duplin area	340	
Hickory area	988	
Kinston sheet	257	
Mount Mitchell sheet	497	
Newbern sheet	46	
Parmele area	236	
Perquimans and Pasquotank counties	215	
Princeton sheet	248	
Saluda area	190	
Statesville area	784	
		5,837
North Dakota:		
Cando area	283	
Fargo area	406	
Grand Forks area	314	
Jamestown area	496	
		1,499
Ohio:		
Ashtabula area	340	
Columbus area	472	
Coshocton County	551	
Montgomery County	480	
Toledo area	403	
Wooster area	469	
		2,715
Oregon:		
Baker City area	158	
Salem area	284	
		442
Pennsylvania:		
Adams County	534	
Lancaster area	269	
Lebanon area	669	
Lockhaven area	278	
		1,750
Porto Rico:		
Arecibo to Ponce		330
Rhode Island:		
State		1,085
South Carolina:		
Abbeville area	1,006	
Campobello area	515	
Charleston area	352	
Darlington area	599	
Lancaster County	486	
Orangeburg area	709	
		3,667
South Dakota:		
Brookings area		484
Tennessee:		
Clarksville area	547	
Davidson County	501	
Greeneville area	664	
Lawrence County	618	
Pikeville area	440	
		2,770

Areas of soil surveys in the United States to December 31, 1904—Continued.

	Square miles.	
Texas:		
Anderson County	1,069	
Austin area	705	
Brazoria area	845	
Houston County	430	
Jacksonville area	100	
Lufink area	99	
Nacogdoches area	97	
Paris area	548	
San Antonio area	484	
Vernon area	277	
Willis area	215	
Woodville area	100	
		4,969
Utah:		
Bear River Valley	334	
Provo area	373	
Salt Lake sheet	249	
Sevier Valley	235	
Weber County	310	
		1,501
Vermont:		
Vergennes area		227
Virginia:		
Albemarle area	1,410	
Appomattox County	340	
Bedford area	632	
Gloucester County	250	
Leesburg area	419	
Norfolk area	303	
Prince Edward County	430	
York Neck area	405	
		4,189
Washington:		
Sunnyside sheet	224	
Walla Walla area	201	
Yakima sheet	85	
		510
Wisconsin:		
Janesville area	451	
Superior area	482	
Viroqua area	504	
		1,437
Wyoming:		
Laramie area		309

THE PRINCIPAL INJURIOUS INSECTS OF 1904.

By F. H. Chittenden, Sc. D., *In Charge of Breeding Experiments, Bureau of Entomology.*

The year 1904 has been the most remarkable in the memory of present-day entomologists as regards the falling off in numbers of our most important insect pests. This year has witnessed a very general continuation of conditions begun in 1901, brought about chiefly by atmospheric changes, abnormally cold winters and cool summers, and damp weather, which have caused a constant decrease of noxious species in the country at large. Extreme losses from insects have been the exception, and comparatively few forms have been more than locally troublesome. Nevertheless, nearly as many complaints of insect injury have been received as in previous years.

The most important insect of the present is the Mexican cotton boll weevil, which has extended its range in Texas and in Louisiana until it has now invaded fully a third of the cotton-growing district of the United States. Also the bollworm has not abated in the cotton region, and the leaf worm has been more abundant than for many years past.

A single new pest has been introduced from abroad, the pepper weevil, which has been destructive in Texas, having been brought or spread from Mexico. The imported willow curculio, spreading by artificial means, has extended its distribution westward perhaps more rapidly than has been recorded of any other species, and is now established in North Dakota. The strawberry thrips menaces the growing of tobacco under shade as a means of producing "Sumatra" wrapper. The brown-tail moth is steadily increasing its range, and unless stringent measures are adopted to suppress the gypsy moth it seems probable that the latter species will also spread beyond its present limit. The stalk borer has been more injurious than in many previous years combined. The same is true of the onion and cabbage maggots, and to a less extent of the seed-corn maggot and black onion fly. Some other root-infesting insects, notably wireworms and the beet aphis, have been prominent as pests. Leaf-beetles and flea-beetles have been only locally troublesome in the Eastern States, but west of the Mississippi Valley much injury to the sugar beet has been accomplished by several species. Local outbreaks of cankerworms have been noted, and the cottony maple scale has been exceedingly troublesome over a very considerable area.

Such important orchard pests as the codling moth, plum curculio, peach-tree borer, and fruit-tree bark-beetle, have been less injurious than usual. The commoner garden insects have also been less abundant. Moderate losses have been incurred from cabbage worms, and still less from the squash bug and squash-vine borer. General crop pests, such as cutworms, grasshoppers or locusts, white grubs, army worms, and plant-lice, have been less troublesome than they ordinarily are. Fewer complaints are received each year of the San Jose scale, partly owing to the fact that remedial work which is being carried on against this pest generally throughout the country has done much to lessen its ravages. The pea and bean weevils, Hessian fly, chinch bug, blister beetles, and billbugs have scarcely been heard from. Some shade-tree defoliators, particularly the fall webworm and elm leaf-beetle, were only locally numerous and did no serious harm. Various insects of southern origin, which in

many years in the past have been destructive in the North, have practically disappeared as pests. This is most true of the harlequin cabbage bug, the corn stalk-borers, and cabbage looper. The last occurred so late and in such limited numbers as to be easily controlled before material injury had been accomplished. Remarkably few complaints were received of injury to stored cereal and other products.

As there has been no change in atmospheric conditions, the insect outlook for 1905 is very promising, there being no reason to believe that the same conditions which have prevailed for several years past will not continue. As methods of controlling insect pests are being carried out more extensively than ever before, even less injury than hitherto is to be anticipated.

APPLE LEAF-HOPPER (*Empoasca mali* LeB.).—Very destructive in nurseries in Minnesota and Missouri, where it was given special study. It was very abundant in the District of Columbia. Kerosene emulsion applied as a spray, using a specially prepared apparatus with a wide-geared cart, promises success as a remedy.

APPLE MAGGOT (*Rhagoletis pomonella* Walsh).—Apparently more abundant than for several years past, particularly in Ohio.

ARMY WORM, FALL (*Laphygma frugiperda* S. & A.).—This species was reported injuring rice plantations on the Cape Fear River, North Carolina, in July, and fields of sorghum and grasses at Oswego, Kans., in early September. It also injured corn in Barbados, West Indies.

ASPARAGUS BEETLE, COMMON (*Crioceris asparagi* Linn.).—Injurious in Maryland and along the Hudson River in New York. A report has also been received of its appearance in California, but this has not been verified.

BEAN LEAF-BEETLE (*Cerotoma trifurcata* Forst.).—Considerable injury to beans about Norfolk, Va.

BEAN LADYBIRD (*Epilachna corrupta* Muls.).—Very destructive in New Mexico.

BEDBUG (*Klinophilos* [*Acanthia*] *lectularia* Linn.).—Experiments with hydrocyanic acid gas as a means of eradicating this species in dwellings, conducted in Virginia and the District of Columbia, were successful.

BEET APHIS (*Pemphigus betæ* Doane).—Serious injury to sugar beet. Observed during the year in Utah, Idaho, Washington, Oregon, California, and Colorado.

BEET LEAF-MINER (*Pegomya vicina* Lint.).—Attracted attention in sugar-beet fields in northern Colorado, Idaho, Oregon, Washington, California, Michigan, and Wisconsin.

BEET SAWFLY (*Taxonus nigrisoma* Nort.).—Reared from larvæ attacking sugar beet and dock in northern Michigan.

BILL-BUGS.—Not specially troublesome during the season, with one exception, *Sphenophorus callosus* Ol., which was injurious to corn in Grant County, N. Mex.

BLACK FLY (*Simulium venustum* Say).—Given economic study in Texas.

BLISTER BEETLES.—Much less numerous than in 1903. The black blister beetle (*Epicauta pennsylvanica* DeG.) was injurious to onions in southern Texas by eating the tops off near the ground. The striped and three-striped blister beetles (*Epicauta vittata* Fab. and *E. lemniscata* Fab.) were reported completely stripping leaves and squares of cotton, leaving only bolls, in South Carolina. The ash-gray blister beetle (*Macrobasis unicolor* Kby.) was injurious to alfalfa at Knoxville, Tenn., and to alfalfa and sugar beet in western Colorado.

BOLL WEEVIL, COTTON (*Anthonomus grandis* Boh.).—During the year 1904 this species has extended its range in Texas and Louisiana, according to estimate by Mr. W. D. Hunter, to about one-third of the cotton area of the United States. The loss for the season is estimated at $22,000,000. (See p. 191.)

BOLLWORM (*Heliothis obsoleta* Fab.).—According to estimates by Mr. A. L. Quaintance the injury occasioned by this pest, one year with another, to the principal crops attacked results in losses about as follows: To sweet corn, $1,909,790; field corn, $16,565,165; cotton, $11,650,820; tomatoes, $160,456, a total of $30,326,231. Investigations by the Bureau of Entomology show that injury to cotton may be best avoided by the production of the earliest crop possible.

BROWN-TAIL MOTH (*Euproctis chrysorrhœa* Linn.).—This recently imported European pest was the subject of special investigation by Mr. C. L. Marlatt, Bureau of Entomology, in New England. It has spread in a northerly direction to new localities in Maine and New Hampshire and has become established at St. Johns, New Brunswick.

CABBAGE MAGGOT, IMPORTED (*Pegomya brassicæ* Bouché).—Unprecedented damage by this insect to cabbage, cauliflower, turnip, radish, and other crucifers in New York, Pennsylvania, New Hampshire, Michigan, and Indiana.

CABBAGE WORMS.—Somewhat less than normally destructive. Toward the end of August the imported cabbage worm (*Pontia* [*Pieris*] *rapæ* Linn.) appeared in great numbers in the District of Columbia, but was completely checked by parasites. The southern cabbage worm (*Pontia* [*Pieris*] *protodice* Boisd.-Lec.) was injurious at Macon, Ga.; the cross-striped cabbage worm (*Evergestis rimosalis* Guen.) in the District

of Columbia. The cabbage looper (*Autographa brassicæ* Riley) was moderately abundant near the District of Columbia, but was checked by arsenicals. The black-headed horse-radish worm (*Evergestis straminalis* Hbn.) was injurious to cabbage near Ottawa, Canada, and in Nova Scotia and Prince Edward Island. The imported cabbage webworm (*Hellula undalis* Fab.) was very destructive in Georgia.

California red scale (*Aspidiotus aurantii* Mask.).—Seriously infested citrus trees in California.

Cankerworm, spring (*Paleacrita vernata* Peck).—Increased in destructiveness in Ohio, Pennsylvania, Illinois, and eastern Kansas.

Canna leaf-roller (*Calpodes ethlius* Cram.).—This caterpillar continued its ravages on canna, doing particularly serious damage in canna fields in Alabama and at New Orleans, La.

Carrot beetle (*Ligyrus gibbosus* DeG.).—Observed injuring young sugar beet at Sugar City and Rocky Ford, Colo. It was generally abundant and moderately injurious in the corn-growing region of the South.

Cherry leaf-beetle (*Galerucella cavicollis* Lec.).—Very injurious to cherry and peach foliage about Morgantown, W. Va.

Chestnut weevils (*Balaninus rectus* Say and *B. proboscideus* Boh.).—Attracted similar attention to the previous year by their injury to chestnuts in Virginia and Pennsylvania. Considerable study was devoted to the life economy of these species, which has led to the discovery that bisulphid of carbon, cold storage, and certain other remedies are effectual.

Chinch bug (*Blissus leucopterus* Say).—Less of a pest than for some time. A report of injury to grasses in Florida was received.

Chinch bugs, false (*Nysius angustatus* Uhl. and *N. parallelus* Uhl.).—Occasion of considerable trouble by sucking the juices of various plants, including potato, mustard, and strawberry in Texas, as well as similar injury in North Carolina and New Mexico.

Chrysanthemum lace-bug (*Corythuca marmorata* Uhl.).—Severe damage to chrysanthemum at Booneville, Miss., and Montgomery, Ala.

Cigarette beetle (*Lasioderma serricorne* Fab.).—Less destructive than in many preceding years. It was quite troublesome in residences in Washington, doing damage to rugs, carpets, and tapestry, and it was feared that it might spread to a valuable library. It was partially eradicated in one house by means of hydrocyanic acid gas. Injury to cigars was reported from Indian Territory.

Codling moth (*Carpocapsa pomonella* Linn.).—Judging from reports, less destructive than usual during the year. A spray of arsenate of lead was extensively used in Colorado with splendid results.

Colaspis rootworm (*Colaspis brunnea* Fab.).—The adult was reported damaging cotton squares, bolls, and blossoms in Alabama, Mississippi, and Tennessee. *Colaspis favosa* Say defoliated peach trees in north Georgia.

"Conchuela" (*Pentatoma ligata* Say).—Much damage to cotton in northern Mexico and the subject of special investigation by A. W. Morrill, Bureau of Entomology.

Corn stalk-borer (*Diatræa saccharalis* Fab.).—After having remained in the background for several years, this insect did considerable damage to corn near Hawkinsville, Ga. It was remarkably scarce in the South and not observed at all in the more northern limits of its range.

Cotton leaf-worm (*Alabama* [*Aletia*] *argillacea* Hbn.).—General infestation was noted over Texas, Indian Territory, Arkansas, Georgia, Louisiana, and in portions of Mississippi. Extensive defoliation took place in September and October, and young bolls were gnawed. In Texas this unusual defoliation accomplished more good than harm, since the loss of the shade afforded by the leaves created conditions unfavorable to the operations of the boll weevil in that State.

Cottony maple scale (*Pulvinaria innumerabilis* Rathv.).—More generally abundant than in any year hitherto, causing considerable alarm in many regions, from New York, New Jersey, and West Virginia westward to Kansas, Colorado, and South Dakota. Boxelder and elm, in addition to maple, were reported attacked.

Croton bug (*Ectobia germanica* Linn.).—Successfully destroyed in dwellings in Virginia by hydrocyanic acid gas fumigation, the effect being to stupefy the insects until they could be swept up and destroyed.

Cowpea-pod weevil (*Chalcodermus æneus* Boh.).—Reported quite destructive to young cotton plants in Randolph and Terrell counties, Ga., during May. Similar reports were received of injury in Alabama and Louisiana.

Cutworms.—Not the subject of very serious complaint during the year, although injuries were noted in Michigan, Colorado, Georgia, and Texas. The red-backed cutworm (*Paragrotis ochrogaster* Guen.) was most injurious in Canada east of the Rocky Mountains. The variegated cutworm (*Peridroma saucia* Hbn.) did much damage to cotton and peas in Georgia; also to cotton in Texas, and to carnations in Michigan.

ELM LEAF-BEETLE, LARGER (*Monocesta coryli* Say).—Destructive to elm foliage in Virginia and West Virginia.

ELM LEAF-BEETLE, IMPORTED (*Galerucella luteola* Mull.).—On the whole, much less troublesome than in earlier years. It made its first appearance at Dayton, Ohio, and was recorded as far north as Glens Falls, N. Y.

FICKLE MIDGE (*Sciara inconstans* Fitch).—Normally abundant, and reported troublesome on various greenhouse plants in the District of Columbia, Pennsylvania, Illinois, and Nevada.

FLEA-BEETLES.—Not so destructive as usual. The eggplant flea-beetle (*Epitrix fuscula* Crotch) was concerned in injury to sugar beet in Colorado, Idaho, and Utah. The potato flea-beetle (*Epitrix cucumeris* Harr.) caused a loss to potato growers in Colorado, estimated at $500,000, injury having been chiefly due to the beetles boring into the tubers. The red-legged flea-beetle (*Crepidodera rufipes* Linn.) was destructive to the foliage of peach in Ohio and to peach and apple in West Virginia, its attack following the clearing of locust for the planting of orchard trees. The western cabbage flea-beetle (*Phyllotreta pusilla* Horn) did great injury to sugar beet in western Colorado and in Utah and Idaho. The pale-striped flea-beetle (*Systena blanda* Mels.) did severe damage to cotton near Jackson, Ga., and *S. tæniata* Say to sugar beet in the Rocky Mountain and Pacific region.

FLOUR BEETLE, CONFUSED (*Tribolium confusum* Duv.).—Considerable damage to malt stored in St. Louis. It was also, with other grain insects, troublesome in stored wheat at Columbus, Ohio, where it was successfully destroyed with bisulphid of carbon. On the whole it was much less complained of than in 1903. Hydrocyanic acid gas was thoroughly tested by the Bureau of Entomology, and, while not perfect, proves a good remedy.

FULLER'S ROSE BEETLE (*Aramigus fulleri* Horn).—Abundant in strawberry fields in Los Angeles County, Cal., where it was studied in cooperation with the Bureau of Entomology.

GOOSEBERRY FRUIT FLY (*Epochra canadensis* Loew).—Severely injured gooseberry and currant in northern Colorado.

GRAPE ROOT-WORM (*Fidia viticida* Walsh).—Less injurious in Ohio than in the past. The long-legged grape fidia (*Fidia longipes* Mels.) did considerable damage to the vine in North Carolina.

GRAPE BERRY-MOTH (*Polychrosis viteana* Clem. [*Eudemis botrana auct.*]).—Considerable damage to vineyards in Ohio, New York, and Pennsylvania.

GRASSHOPPERS OR LOCUSTS.—Less troublesome during 1904 than for many years. The conditions regulating the breeding habits of these species were studied by a special agent of the Bureau of Entomology in Nebraska, northern Colorado, Wyoming, Montana, and western Kansas, and were found to be greatly improving.

GYPSY MOTH (*Porthetria* [*Ocneria*] *dispar* Linn.).—Special study by the Bureau of Entomology during the season. It appears to be still confined to the immediate neighborhood of Boston, Mass., and Providence, R. I.

HARLEQUIN CABBAGE BUG (*Murgantia histrionica* Hahn).—This pest caused very severe injury to cruciferous plants in Georgia and Texas, but near Washington, D. C., and northward it has almost entirely disappeared.

HESSIAN FLY (*Mayetiola* [*Cecidomyia*] *destructor* Say).—Taking the country at large, the fly has been less of a pest during the last year than for some time.

HOP LOUSE OR APHIS (*Phorodon humuli* Schrank).—A subject of special investigation in California. Spraying with kerosene emulsion, combined with tobacco and with whale-oil soap combined with quassia, were effective in destroying the pest.

IDAHO OR MORMON CRICKET (*Anabrus simplex* Hald.).—Occurred in unprecedented numbers in Routt County, Colo., and in some parts of Utah, destroying crops of grain, hay, potatoes, and "everything planted in gardens."

JUNE BEETLE, GREEN (*Allorhina nitida* Linn.).—The white grub of this species was reported injurious on tennis grounds on Long Island, and to celery and strawberry beds in Virginia, but the beetle was rare beyond the memory of local entomologists about the District of Columbia, and in Pennsylvania, which militated against reported good results of the use of kerosene emulsion and whale-oil soap the previous year.

MEDITERRANEAN FLOUR MOTH (*Ephestia kuehniella* Zell.).—Reported as causing injuries in mills in new localities in California, New York, Ohio, Indiana, Illinois, Iowa, Pennsylvania, Minnesota and Georgia.

MELON LOUSE (*Aphis gossypii* Glov.).—Troublesome in melon districts in Colorado.

MOSQUITOES (*Culicidæ*).—Mosquitoes were the subject of more extensive investigations in this country as well as abroad than in any previous year. Work on a considerable scale was done in New York and New Jersey, and is planned for the future.

"NEW ORLEANS" ANT (*Iridomyrmex humilis* Mayr.).—Caused serious trouble in dwellings in New Orleans, its ravages extending to fields, flower beds, and sidewalks. It was also troublesome in carrying and fostering aphides, scales, and mealy bugs.

ONION FLY, BLACK (*Tritoxa flexa* Wied.).—Ordinarily considered rare as a pest, completely destroyed a crop of onions in store in one locality in Pennsylvania. The insects continued breeding in the onions until nothing but a shell was left.

ONION MAGGOT (*Pegomya cepetorum* Meade).—This was one of the most injurious insects of the year, appearing to be prevalent throughout its range, or wherever onions are grown in the more northern States. The losses following its ravages were enormous. General infestation of onion fields was reported in New York, New Jersey, Pennsylvania, Michigan, New Hampshire, Connecticut, and Ohio. Reports were also received from Texas and Oregon.

OYSTER-SHELL SCALE (*Mytilaspis pomorum*=*Lepidosaphes ulmi* Linn.).—From western Pennsylvania (about Pittsburg), Ohio, and Illinois come reports of serious injury to poplar, willow, lilac, elm, and horse-chestnut. In northern Ohio nurserymen are experiencing great difficulty in controlling this scale.

PEA LOUSE (*Nectarophora destructor* Johns. [*pisi*?]).—Conspicuous by an almost complete absence of complaints, but was noted in Colorado for the first time. Its presence was reported in New Jersey.

PEAR SLUG (*Eriocampoides limacina* Retz.).—Destructive in cherry orchards in Ohio. About the District of Columbia it was somewhat less abundant than usual.

PECAN WEEVIL (*Balaninus caryae* Horn).—Injury to pecan by this species was reported in Texas, Arkansas, and Georgia. Some investigations on its life history were conducted by the Bureau of Entomology in cooperation with correspondents.

PEPPER WEEVIL (*Anthonomus æneotinctus* Champ.).—Observed injuring pepper in southern Texas, where it has evidently been introduced or spread from Mexico.

PLANT-BUGS (*Euschistus servus* Say, *E. variolarius* Beauv., and *E. tristigmus* Say).—Observed in great numbers in September in the District of Columbia attacking asparagus, the first two mentioned also puncturing the pods of okra. *Œbalus pugnax* Fab., a common grass feeder, threatened rice fields in Louisiana. Hilarious green plant-bug (*Nezara hilaris* Say) was injurious to cotton in the South, and to okra in the District of Columbia and vicinity.

PLUM CURCULIO (*Conotrachelus nenuphar* Hbst.).—About held its own as the most important enemy of stone fruits. It has increased markedly as an apple pest. Experiments conducted with a spray of arsenate of lead have given considerable measure of success, particularly when combined with the careful gathering of windfalls, and the agitation of the soil in which the curculios pupate in July and August. In Georgia 15 to 20 per cent of the peach crop was rendered unmarketable through this species. In Ontario, Canada, it destroyed the greater part of the plum crop.

POND-LILY LEAF-BEETLE (*Galerucella nymphææ* Linn.).—Great numbers in the District of Columbia attacking the leaves of basket willow and beans, showing capability of considerable damage to both plants. The species lives normally on pond lily (Nymphæa) and arrowhead (Sagittaria).

POWDER-POST BEETLES (*Lyctus* spp.).—Injury by *Lyctus unipunctatus* Hbst. was noted on the woodwork of electric cars at Steubenville, Ohio.

PURPLE SCALE (*Mytilaspis citricola* Pack.).—Reported to be effectually controlled in Los Angeles County, Cal., by an introduced ladybird, *Rhizobius lophantæ* Blaisd.

RADISH MAGGOT (*Anthomyia radicum* (?)).—Troublesome in Colorado and Canada.

RICE GRUB (*Chalepus trachypygus* Burm.).—Very abundant in the South, especially in the fall in cane fields of southern Louisiana.

ROSE LEAF-BEETLE (*Nodonota puncticollis* Say).—Unusually destructive in Maryland and Virginia, playing havoc with rose bushes, fruit and shade trees, strawberry plants, and shrubbery on lawns.

ROSE WORM, BRISTLY (*Cladius pectinicornis* Fourc.).—Was destructive from the District of Columbia to Missouri.

SAN JOSÉ SCALE (*Aspidiotus perniciosus* Comst.).—Complaints of this species grow fewer each year. The remedy which gives most promise of success is the lime-sulphur-salt wash, which has been used with profit generally during the year, notably in New York, Pennsylvania, North Carolina, Georgia, and Virginia.

SEED-CORN MAGGOT (*Pegomya fusciceps* Zett.).—Exceedingly troublesome, especially in the South—in North Carolina, Louisiana, and Florida—as also in New York. Beans, peas, onion, cantaloupe, cucumber, squash, potato, and cabbage were the principal crops damaged.

SOWBUGS.—In all years the subject of more or less complaint, these creatures have been studied this year, with the result that it has been practically demonstrated that they are more troublesome than generally supposed hitherto. The species under special observation were *Armadillidium vulgare* Latr. and *Porcellio laevis* Latr.

SQUASH BUG (*Anasa tristis* DeG.).—Continues in abeyance, but a limited outbreak occurred in Ohio.

STALK BORER (*Papaipema nitela* Guen.).—More destructive in 1904 than hitherto recorded, operating in most thick-stalked plants, and doing particular injury to corn, potato, and tomato; strawberry and other bush fruits; dahlia and related ornamental plants; as also to wheat and oats. Numerous outbreaks were reported in Pennsylvania and New York, through Ohio to Iowa, Nebraska, and Missouri. Less general injury was noted in Arkansas, West Virginia, North Carolina, and Connecticut.

STRAWBERRY CROWN GIRDLER (*Otiorhynchus ovatus* Linn.).—Conspicuous pest Maine westward to Montana. In Montana and British Columbia, destructive to berry.

STRAWBERRY WEEVIL (*Anthonomus signatus* Say).—Complaints of this species were made in Anne Arundel County, Md., and in North Carolina. In the latter State the loss was estimated at from 10 to 50 per cent of the crop, or $100,000.

SUGAR-BEET ARMY WORM (*Caradrina exigua* Hbn.).—Outbreaks of this species occurred in southern California.

SUGAR-BEET CROWN-BORER (*Hulstia undulatella* Clem.).—Injurious to sugar beet in southern California.

SUGAR-BEET LEAF-BEETLES (*Monoxia puncticollis* Say and *M. consputa* Lec.).—Very destructive to sugar beet in Colorado, Utah, and Idaho. They are usually present in the alkali districts, whence the name of "alkali bugs."

SUGAR-BEET WEBWORM (*Loxostege sticticalis* Linn.).—Extremely and generally destructive to sugar beet in Colorado east of the Rocky Mountains, its operations extending over thousands of acres. Spraying with Paris green proved effective. This and the other sugar-beet pests mentioned were observed by Mr. E. S. G. Titus, of the Bureau of Entomology.

SUGAR-CANE BEETLE (*Ligyrus rugiceps* Lec.).—Very destructive to cane in Louisiana, Mississippi, and Texas, where it was studied by Mr. Titus.

SWEET-POTATO WEEVIL (*Cylas formicarius* Fab.).—Continued its destructive work in Louisiana and Texas, and was reported injurious in Cuba as well.

TARNISHED PLANT-BUG (*Lygus pratensis* Linn.).—Cause of unusual damage to chrysanthemums grown at Haverford, Pa., the principal injury being due to the dying of the tips without blossoming. In the vicinity of the District of Columbia the species was somewhat unusually rare.

TERRAPIN SCALE (*Lecanium nigrofasciatum* Perg.).—Reports of serious infestations of peach, plum, and maple trees come from districts in Maryland, Pennsylvania, Virginia, and Ohio. This scale insect occurs on more than twenty different host-plants.

THRIPS.—Different species attracted considerable attention. The onion thrips (*Thrips tabaci* Lind.) reduced the normal yield of onions in one locality in Ohio by 25 per cent, causing the characteristic blast due to this species. In Texas, in Dimmit County, an entire crop of 600 acres was infested. Similar attack was reported in Kimble County. The strawberry thrips (*Thrips tritici* Fitch) was injurious to tobacco and to blackberry and strawberry blooms in Florida. It threatens to ruin the tobacco crop of that State, more especially where "Sumatra wrapper" is grown under shade. An unidentified thrips did damage in Santa Clara County, Cal., to prune trees by blasting the petals, the loss footing up into the thousands. The cestrum thrips (*Heliothrips femoralis* Heeg.) was present in greenhouses in the District of Columbia and injured sugar beets grown for experimental purposes.

TWIG GIRDLER (*Oncideres cingulata* Say).—Attracted considerable attention in Texas in November, injuring pecan, elm, cotton, rose bushes, pear, hackberry, and salt cedar. Rose bushes were also injured in Florida; hickory, elm, and locust, as well as pecan, in Arkansas; and pecan in North Carolina and Mississippi.

WATERCRESS LEAF-BEETLE (*Phædon æruginosa* Suffr.).—A new enemy to watercress in Pennsylvania in 1903, this beetle did similar injury in 1904, but it is believed that it can be controlled by growing watercress in running water and removing it from houses and ponds where running water can not be obtained.

WILLOW CURCULIO, IMPORTED (*Cryptorhynchus lapathi* Linn.).—Reported doing injury in Ohio, New York, and Michigan, and to have been introduced into North Dakota from Minnesota, showing very rapid distribution through commerce.

WEST INDIAN PEACH SCALE (*Diaspis pentagona* Targ.).—Many complaints of damage from this scale are sent in from Atlantic States south of Pennsylvania. It infests a wide range of plants, but principally peach, cherry, and apricot.

WIREWORMS (*Elateridæ*).—Different species were prevalent in various localities and injurious to a variety of crops. At Auburn, N. Y., they injured the roots of cabbage; at Oxnard, Cal., sugar beets; in Indiana and Virginia, corn. The species in the last State were *Melanotus communis* Gyll. and *M. cribulosus* Lec. In the cotton States much injury, which was not verified, was attributed to the click-beetle, *Monocrepidius vespertinus* Fab., on cotton bolls.

ZEBRA CATERPILLAR (*Mamestra picta* Harr.).—Reported injurious during July to sugar beet in northern Michigan; to garden beets and other vegetable crops at Pittsburg, Pa.

GAME PROTECTION IN 1904.

By T. S. Palmer, *Assistant, Biological Survey.*

During the year 1904 substantial progress was made in game protection, not only in legislation and in administration of the laws, but also in the increased attention which was given to methods of preserving or increasing the stock of game and to the establishment of game refuges and State parks. Widespread interest in the protection of migratory birds was aroused by the Shiras bill (H. R. 15601), which proposed to place migratory game under the jurisdiction of the Federal Government. This measure was introduced in the House of Representatives on December 5, 1904, and referred to the Committee on Agriculture, but was not reported, and consequently did not pass at this session of Congress. Its introduction, however, served to call attention to the subject, and will probably exert a marked influence in the progress of this phase of game protection.

LEGISLATION.

The amount of legislation was small in comparison with that of 1903, owing to the few legislatures in session in even years. It compares favorably, however, with that of either 1900 or 1902, by which it may be properly measured. Twelve of the 17 States and Territories which held legislative sessions during the year made some changes in their game laws. Louisiana and Ohio adopted general game laws, and Louisiana and Mississippi passed the uniform law for the protection of nongame birds already in force in 27 States and 3 Canadian Provinces. Several States gave increased protection to shore birds: Louisiana and Ohio added them to the list of protected game, New York abolished spring shooting, and Massachusetts shortened their sale season; snipe were added to the game list of Iowa, and upland plover to that of New Jersey. An advance was made in opening up Louisiana to nonresident hunters under license and allowing them the privilege of carrying home a limited amount of game and in requiring licenses from unnaturalized foreign-born residents hunting in the State. Vermont, only a few days prior to the opening of the deer season, adopted the license system and required a $15 license of nonresidents hunting deer in the State. Among other changes in the license system may be mentioned the Maryland requirement of a $10 license for shooting on the Patuxent River, and the Nova Scotia $30 moose license. Ohio reduced the license fee from $25 to $15, and Kentucky, following Tennessee, adopted the system of charging each nonresident the fee demanded of nonresidents in his own State. Bag limits were placed on wild turkeys and waterfowl by Iowa, and on all game by Louisiana, and the bag limit on partridges was reduced by Vermont.

Among the retrograde tendencies of the year's legislation were the defeat in Maryland of all general game bills, except the game-warden bill, and the enactment of 17 county game laws; the passage of a bill in New Jersey permitting spring shooting of Wilson snipe and lengthening the seasons for other shore birds and waterfowl; the removal in Virginia of all protection from Wilson snipe; and the adoption of measures in Ohio reestablishing spring shooting of waterfowl, removing protection from prairie chickens and wild turkeys, and allowing a season for doves, previously protected throughout the year.

DECISIONS.

Rarely, if ever, have so many important questions in game protection been decided in a single year as in 1904. Eleven game decisions of more or less general interest were rendered by the higher courts in Arkansas, California, Colorado, Georgia, Illinois, Minnesota, Nebraska, and New York. In Arkansas the provision absolutely prohibiting nonresidents from hunting in the State was held by the supreme court[a] to be unconstitutional in so far as it interfered with landowners hunting on their own premises (State *v.* Mallory, 83 S. W., 955). In Illinois an equally important license decision was rendered by the supreme court of Illinois in the case of Cummings *v.* The People (71 N. E., 1031). In this decision the right of the State to discriminate against nonresidents was also sustained and in addition it was decided that lands owned or rented as game preserves were not farm lands in the meaning of the law and hence owners and tenants were not entitled to hunt without a license. The Colorado decision (Hornbeke *v.* White, 76 Pac., 926) upheld the constitutionality of the game law of 1899. This case, the first game case in the State ever carried to the

[a] In the Yearbook for 1903, page 567, reference was made to this case, which had then been recently decided by the circuit court of Crittenden County.

court of appeals, involved the possession of 300 deer hides, and resulted in a vindication of the authority of the State to maintain its title in the game and to prescribe the conditions under which game should be killed or held in possession.

Two important decisions were handed down in Minnesota, one sustaining the right to prevent trespass on private land used as a duck pass (L. Realty Co. *v.* Johnson, 100 N. W., 94), the other considering the question of excessive fines (State *v.* Poole, 100 N. W., 647). In the latter decision a fine of $10 to $25 for each bird illegally in possession was held to be not excessive, even though the minimum fine for the possession of 2,000 ducks would amount to $20,000.

The supreme court of Nebraska likewise handed down two game decisions, one holding, among other things, that a fine of $5 for each prairie chicken unlawfully in possession was not excessive (McMahon *v.* State, 97 N. W., 1035), the other that the provision of the game law authorizing confiscation of guns and other hunting paraphernalia was unconstitutional in so far as it permitted such property to be confiscated without due process of law. (McConnell *v.* McKillip, 99 N. W., 505.)

Two adverse decisions were rendered in New York, one by the appellate division of the supreme court in a case involving the possession of 36 snow buntings (The People *v.* Cohen, 86 N. Y. Supp., 475), and the other by the court of appeals, finally dismissing the case against the Arctic Freezing Company (The People *v.* Bootman, 66 N. E., 1113). The latter had been before the courts since 1901 and had attracted widespread attention on account of the large fines involved. The main question at issue was whether the State law applied to game imported from other States. The court held that although the law in force at the time the seizure was made did not apply to imported game, nevertheless it was competent for the State to enact such a law. This has already been done in chapter 141 of the acts of 1902.

EDUCATIONAL WORK.

With the ever increasing complexity of game laws the necessity for making their provisions better known and the need of educational work become more and more apparent. Most of the States now publish their game laws in separate form, but a few make no such provision and the public often find difficulty in securing copies of the law or ascertaining the latest amendments. Oregon has recently authorized the publication of 1,500 and New York of 18,000 copies of the game law. In Illinois nearly 200,000 copies of the game law have been distributed during the past two years, and in some sections of North Carolina the wardens are required as part of their duties to post notices containing a digest of the laws and to make a systematic house-to-house distribution of literature on game protection. In carrying on its educational work the Audubon Society of North Carolina distributed through its wardens and by mail over 136,000 copies of publications relating to birds and game protection. In the field of educational work the national committee of Audubon societies during the three years of its existence has taken an important place and is constantly extending its sphere of usefulness. Its main activities during 1904 were directed toward increasing public sentiment in favor of bird protection by distributing publications and coordinating the efforts of the State societies; assisting the different States to secure the passage of better laws; aiding in the enforcement of laws by maintaining wardens to guard the important breeding colonies of birds on the Atlantic coast and in Oregon; cooperating with various agencies to secure protection for birds on the islands of the Pacific, to restrict the traffic in native song birds in the United States, and to prevent the use of plumage of nongame birds for millinery purposes. Its influence thus extends to every phase of bird protection, to every State and Territory, and even beyond the limits of the Union.

ADMINISTRATION AND ENFORCEMENT OF LAWS.

Several changes occurred in the methods of enforcement of State laws. Kentucky made provision for appointment of county fish and game wardens, and Ohio reorganized its existing system. Maryland enacted a new game warden law, legislating all deputies out of office, which led to a practical suspension of the warden work for several months on account of the delay in appointing new deputies. In Maine the omission from the Revised Statutes of 1903 of the right to search without warrant seriously handicapped the commission of that State in its efforts to detect illegal shipments of game and resulted in the export of considerable quantities of game to the Boston market. In Massachusetts the commission finally obtained the right to search with warrant and was enabled to enforce the law much more effectively than formerly.

The large receipts from fees in some of the States which have adopted the license system, notably Illinois, Maine, and Wisconsin, made it possible to place the warden service in those States on a firm basis and permitted a more effective enforcement of

the law than has heretofore been feasible. In Wisconsin 90 deputies were regularly employed under salary and in Illinois 114. The number of prosecutions for violation of the game laws in Illinois from July 1, 1903, to December 17, 1904, was 321, of which 84 per cent resulted in conviction. In Maine 65 cases of illegal killing of moose were reported. Many of these lacked the evidence necessary for prosecution, but a number of convictions were secured; in each of 4 cases the offender paid a fine of $500, and in a fifth case served a sentence of four months in jail. In Montana one of the most noted game cases in recent years was brought to a successful conclusion. The defendant, a resident of New York, was convicted of unlawfully killing 4 mountain sheep in Teton County and 1 antelope in Fergus County and was fined $500 for each offense. In North Carolina, where a force of 45 wardens was employed by the Audubon Society, 66 convictions were secured, of which 25 were for killing game out of season, 18 for violation of the nongame bird law, and 17 for hunting on other persons' land without permission. Pennsylvania paid special attention to the enforcement of the law relating to foreigners hunting without license and secured 117 convictions for this offense, or nearly 25 per cent of all the year's convictions under the game law.

In New Jersey the number of convictions for violations of the game laws was 308, or over 90 per cent of the prosecutions, and of these 103 were for offenses against the provisions protecting nongame birds. Several severe penalties were imposed, among which may be mentioned 4 fines of $100 each, one of $140, and 18 sentences of imprisonment for periods ranging from 10 days for killing a snowbird to 90 days for killing 2 robins.

A new field of activity for warden forces was developed through the loss of birds occasioned by the severe winter of 1903–4. Arrangements were made by the State wardens of Maryland and Indiana to feed quail and other game birds during severe weather, grain for this purpose being purchased and distributed by the regular deputies. Efforts along the same line were made by associations and private individuals. These measures were so successful that feeding birds in winter is likely to become a regular feature of warden work.

CONDITION OF THE GAME.

Unfortunately no means now exist for obtaining detailed reports on the condition of game in various parts of the United States. The reports of State game officials often leave much to be desired, and only occasionally a special report is made like that recently undertaken in Massachusetts.[a] Enough data are, however, available to show the general conditions existing in certain sections. The cold winter of 1903–4 caused great mortality among the quail in Indiana and Michigan, and particularly in Massachusetts, where 90 per cent of the birds were estimated to have perished. The condition of ruffed grouse in Massachusetts and Pennsylvania was likewise unsatisfactory, but in Minnesota and Wisconsin the birds were more than usually abundant, so much so that they were brought into the Chicago market in sufficient numbers to lower the price. In Michigan conservative estimates by deputy wardens stationed along the lines of the Detroit and Mackinac and the Michigan Central railroads placed the number of partridges carried south over these roads during the open season at more than 16,000. Careful investigation on the part of the game commissioner of Illinois, based on reports collected from the wardens during each month in the autumn, showed the condition of game of his State to be very satisfactory. Prairie chickens, which had been protected for two years, were found in two-thirds of the counties, and in some sections were rapidly increasing. In Nebraska the strict enforcement of the nonexport law, preventing shipment of game in large quantities to eastern markets, was largely responsible for a greater abundance of prairie chickens than had been noted for several years. In Montana the season was especially favorable for upland game birds. The autumn flight of woodcock in the Middle and North Atlantic States was unusually good, and many birds were reported from various sections. The flight of waterfowl both in the Mississippi Valley and along the Atlantic coast was also larger than usual. In Currituck County, N. C., the local gunners received about $100,000 for the ducks and geese sold during the winter of 1904–5. States in the North which have stopped spring shooting report ducks breeding in many places where recently they were unknown, as, for example, in western and northern New York, where four species remained to breed in the summer of 1904. A striking illustration of the effect of spring protection was afforded in Mon-

[a] Forbush, The Decrease of Certain Birds in New England, Auk, XXII, pp. 25-31, 1905. A more extended paper is to appear in the Report of the Massachusetts State Board of Agriculture now in press.

tana. In 1903 shooting was stopped at the beginning of the year, and thousands of ducks bred and reared their young in the State, but in 1904, the game law having been declared unconstitutional and the previous law revived, no protection was afforded until May 1, and it was rare to find a single brood on ponds where hundreds of birds could have been seen the previous year.

In the case of big game there seems to have been a decrease in deer in some of the principal States in the East and an increase in some parts of the West. Maine reports some decrease in moose and a marked decrease in the number of deer during the past two years, attributed to the fact that killing has probably exceeded the annual increase. In 1904, 222 moose and 3,558 deer were shipped through Bangor, as compared with 232 moose and 3,786 deer in the previous year; but these figures by no means represent the entire number of big game killed in the State. In the Adirondacks many deer perished during the winter. This destruction was at first attributed to disease, but was afterwards considered to be due to the severe season. The number of deer shipments was noticeably less than that of the previous year, comprising 1,618 carcasses, 124 saddles, and 152 heads, as compared with 1,961 carcasses, 145 saddles, and 188 heads in 1903. The number of black bears killed in 1904 was 106.

In Michigan there was a decided falling off in the number of deer killed—7,000 as compared with 22,000 in 1903. This decrease was probably due in part to unfavorable weather during the open season of 1904, and also in part to the increase of wolves. In Montana the warden reports a steady increase in big game during the last three years: moose, caribou, and mountain sheep, now absolutely protected, are becoming numerous; mountain goats are probably more numerous than in any other State, except Washington; deer are increasing in all parts of the State, and elk are very plentiful in many sections, the number being estimated at 25,000 to 30,000 or more. In Wyoming also the State warden reports the outlook very favorable. Moose have absolute protection; sheep are now found in the Shoshone, Teton, Gros Ventre, Wind River, and Bighorn mountains, and a few hundred are still left; deer are scattered throughout the State and show a decided increase during the past three years. Antelope are still numerous in Crook and Weston counties, a few hundred range in Shirley Basin in Carbon County, and about 5,000 in Uinta, Fremont, and Sweetwater counties. About 200 elk are found in the Big Horn Mountains and about 25,000 in the Yellowstone Forest Reserve. The big game killed in 1904 numbered about 560 antelope and 1,100 elk, but statistics are lacking in the case of deer and mountain sheep. The acting superintendent of the Yellowstone National Park reports that the winter of 1903–4 was a favorable one for the game in the park. The new buffalo herd now numbers 39. Mule deer are increasing and becoming tamer each year, 120 being counted on the parade ground of Fort Yellowstone one day during the winter. The band of mountain sheep which winters on Mount Evarts did well, and a new band of about 100 was seen near the northwestern corner of the park. The herd of antelope which winters near Gardiner also did well, and about 1,150 were counted during the winter. The number of bear remains about the same. Mountain lions are increasing, and are so destructive to elk, deer, and mountain sheep that it has been necessary to take steps to destroy them.

IMPORTATIONS OF LIVE MAMMALS AND BIRDS.

During the calendar year 330 mammals and 271,342 birds were imported into the United States under permit. Among the mammals were 11 beaver from Canada and 106 squirrels from Europe. Of the birds 232,617 were canaries, 942 pheasants, 3,568 quail, 1,043 other game birds, and 33,172 miscellaneous species. Among the last-mentioned species were several from India seldom brought to the United States, a horned screamer and several other rare species from South America, and a Somali ostrich (*Struthio molydophanes*), the first ever brought to this country. Two shipments of 50 Madagascar weavers (*Foudia madagascariensis*) are also of interest, as they belong to a species which might become injurious should it once gain a foothold in this country.

Several entries, both of eggs and birds, show the progress of efforts to stock covers with foreign game birds, chiefly pheasants, partridges, quail, capercailzie, and black grouse. The total number of eggs imported was 2,858, of which about 660 were those of partridges and the remainder those of pheasants. Among the consignments of game birds was one containing 192 Hungarian partridges, destined for South Carolina. In spite of repeated attempts, the introduction of the European partridge into the United States has not yet been satisfactorily accomplished, and experiments with eggs are not more successful than with birds, less than 50 per cent of those imported in 1904 having hatched. The importation of Chinese quail for market purposes in California was practically stopped early in the year by the enforcement of a provision

in the State law prohibiting the sale of these birds. Two shipments of Mexican quail, one for California, the other for Bowling Green, Ky., also deserve mention. By far the most interesting game birds imported, however, were about 100 capercailzie and 25 black grouse. These birds were liberated on Grand Island, Mich., which a private corporation is converting into an important game preserve. This experiment marks a notable step in the introduction of the capercailzie into America, and its result will be watched with even greater interest than that made by the fish and game commission of Ontario in 1903.

PRESERVES.

The interest in private preserves continues to increase in all sections of the country. The record of the year shows the establishment of at least 25 private preserves in a dozen or more States. In California, particularly, ducking grounds are in great demand, and the number of preserves has increased rapidly in recent years. In Southern California, where suitable grounds are scarce, artificial ponds have been constructed and lands overflowed in some cases to make conditions more attractive to the birds.

The movement toward establishing State game refuges and parks received added impetus in several Eastern States. In Indiana the forest reserve at Henryville was stocked with Mongolian pheasants. In Minnesota some 20,000 acres of land in St. Louis County north of Lake Superior were given to the State by act of Congress of April 28, 1904. This reservation, while primarily for experimental forestry, may in time become a forest, fish, and game preserve. In New York the legislature fixed the boundaries of the Catskill Park and set aside all lands now owned by the State within these limits. In pursuance of the policy of restocking the Adirondack Park, it made an appropriation of $500 for the purchase of beaver and seven of these animals were obtained as a nucleus for future colonies. Better success is anticipated than in the case of the moose, which have already disappeared, although liberated only a year or two ago. The herd of 22 elk introduced in 1901 has increased to about 200.

Progress in the matter of Federal game refuges was quite as marked as that in the case of State parks. On Pelican Island Reservation, Florida, established in 1903, conditions were unusual. The pelicans arrived at the reservation early in the season and began to nest on two small flats adjoining the main island, but in February a storm destroyed many of the eggs and young, and the birds left the reservation early in the spring. In November, however, they returned in considerable numbers and began nesting as usual on the main island, where they are guarded by a warden and are protected by the State law. A second small reservation comprising Breton, Old Harbor, and Free Mason islands, off the coast of Louisiana near the mouth of the Mississippi River, was set aside by order of the President on October 4, 1904, as a game refuge and breeding ground for birds. Large numbers of ducks resort to these islands in winter and certain species of terns breed there in spring and summer. A bill to create a game refuge in the Wichita Forest Reserve was favorably reported by the Committee on Public Lands of Congress and passed the House of Representatives on December 12. A few weeks later it passed the Senate, and on January 24, 1905, became a law. This is the largest game refuge of the kind in the United States. When the general bill authorizing the President to establish game refuges which has been pending before Congress for two years or more is finally passed, similar refuges will undoubtedly be established in other forest reserves in the West.

STATE ROAD LEGISLATION AND APPROPRIATIONS.

By M. O. Eldridge, *Road Expert, Office of Public Road Inquiries.*

A considerable share of the lawmaking in regard to roads during 1904 was directed toward the regulation of motor vehicles on country highways. Much attention was also given to measures intended to stimulate and aid in the construction and improvement of roads.

Connecticut.—The regular biennial appropriation for State aid in road building was available. It amounted to $225,000 for 1903–1904.

Delaware.—Under a law passed in 1903 the State appropriation for road building in 1904 was $30,000. The State pays one-half the expenses of public-road construction.

Iowa.—Three laws were made in April, 1904. First was an act (chap. 73, 1904) empowering county and city authorities named to procure, under condemnation if necessary, any lands needed for gravel or other material for improving roads and streets. A second law (chap. 52, 1904) provides for the appointment of a State high-

way commission. The Iowa State College, at Ames, is to act as such commission. The duties of the commission shall be to devise and adopt plans and systems of highway construction and maintenance, disseminate practical information on road construction, and assist in building object-lesson roads. The control of automobiles is the object of third act (chap. 53, 1904), providing registration, numbering, limit of speed, brakes, bells, lamps, signals, etc., for motor vehicles. Violation is punishable by $25 fine for a first offense; $25 to $50 fine, or jail sentence not exceeding thirty days, for subsequent offenses.

KENTUCKY.—Provision for the issue of county bonds to obtain money for road construction is made by a law passed in March (chap. 77, 1904). Submission to a vote of the people of the county is required, and a petition of 15 per cent of the qualified voters must precede such submission. A county tax not to exceed 50 cents on $100 may be levied to pay off the bonds. Another act (chap. 98, 1904) enables the road supervisor to condemn by legal process land or material needed for building roads or bridges. A motor-vehicle law (chap. 122, 1904) fixes a speed limit, requires reasonable precautions to prevent frightening draft horses on the road, and provides for lights and signals. The penalty is a fine of $10 to $100.

MARYLAND.—Motor vehicles (chap. 518, 1904) must be registered, numbered, provided with lights, brakes, locks, and signals, and limited to speeds named in the law. The motor vehicle must stop at the roadside when animals in transport or in use are frightened by it; and racing of any kind is forbidden. The penalty for violation is from $20 to $1,000 or three months in jail. Another act (chap. 225, 1904) provides State aid for road building to a maximum of $200,000 annually, one-half of cost to be paid by the State. This aid is apportioned to each county in the ratio of the county's public-road mileage to the total State mileage.

MASSACHUSETTS.—City and town governments are authorized (chap. 125, 1904) to contribute money, labor, or materials to any highway which the State commission may construct in the city or town. There is an appropriation of $490,000 a year to pay three-fourths the cost of State roads constructed in the several counties.

MISSISSIPPI.—An amendment to section 311 of the annotated code of 1892 (chap. 140, 1904) enables any county to issue bonds, to run not to exceed twenty-five years, for the construction of public roads, and provides for a special tax to pay off such bonds. These bonds, however, must not raise the bonded indebtedness of the county above 5 per cent of its taxable property.

NEW JERSEY.—Planting and care of shade trees in the public highways of cities is authorized (chap. 142, 1904), the cost of planting to be borne by the owner of abutting property. Two minor acts (chaps. 133 and 138, 1904) supplement the laws for acquisition of turnpikes and control of plank roads. The State appropriation for road building, 1904, was $250,000, and the average cost of macadam roads $7,000 per mile, 14 feet wide and 6 inches deep. The State pays one-third the cost of public roads.

NEW YORK.—A motor-vehicle law (chap. 538, 1904) replaces previous legislation on this subject. It provides for registration, numbers, badges, brakes, lamps, signals, etc., and directs that on meeting animals in use on the road every reasonable precaution must be taken by the motor operator to prevent accident. On signal from the person in charge of the animals the motor vehicle must stop and, if necessary, cause the motor to cease running until the danger has passed. Speed limits are fixed, but races are provided for under the control of local authorities and with proper restrictions for the safety of the public. Local ordinances requiring license or excluding from the highway motor owners who have complied with the State law are forbidden. Penalties for violation of the law run from $25 fine to $100 fine and ten days' imprisonment. Other acts (chaps. 297, 609, and 612) make changes in the relations of the State engineer to the actual work of road construction, and authorize the highway commissioner to take under process of law any ground necessary for ditches or drains in connection with road building. The total amount available for road building and maintenance in 1904 was $3,524,480. The average cost of macadam roads in the State in 1903 was $8,063 a mile. The State pays one-half for public roads.

OHIO.—Counties are authorized (p. 131, 1904) to buy toll roads and maintain them as free turnpikes. Bond issues not to exceed $225,000, with tax levy not to exceed 1 cent on $100 for payment, are provided for; but the bonds must be voted by the people of the county. Another act (p. 575, 1904) permits the creation of separate road districts of the several townships of the State and authorizes a tax for improvements. The tax may not exceed 6 cents on $100. The creation of the road district must be voted by the people of the township. A third law (p. 550, 1904) provides that upon petition of 100 taxpayers of the township for public-road improvement the trustees of any township must hold an election on the question of improving roads by general taxation. A fourth law (p. 434, 1904) provides that any county through which the

old National road extends shall expend on its improvement all the money on hand or henceforth received as tolls on that road.

PENNSYLVANIA.—The apportionment from the State fund for road building, an original total of $6,500,000, was $500,000 for 1904. The State pays two-thirds the cost of public-road construction.

RHODE ISLAND.—A motor-vehicle act (chap. 1157, 1904) provides for registration, numbers, locks, brakes, signals, lights, and directs the operator to use every reasonable precaution to avoid frightening horses on the road. The penalty is $20 or imprisonment not exceeding three months. Money collected is to go for road improvement. An appropriation of $105,000 for State aid in road building was made for 1904.

SOUTH CAROLINA.—An annual tax levy is provided for (chap. 216, 1904). Upon a written petition of one-fourth the resident electors and one-fourth the resident freeholders 21 years old, the county commissioner must order an election upon the question of a tax levy, not to exceed 2 cents on $100. Any surplus of the tax collected in any year, which remains till the next year, is still to be used for road improvement.

VERMONT.—The Vermont plan for State aid for highway improvement assesses annually a State tax of 5 mills on the dollar, to which is added the revenues from the local-option license law. The fund for the year 1904 is $130,811.37. This is apportioned to all the towns in the State, proportional to mileage of roads in each town.

VIRGINIA.—A comprehensive law (chap. 106, 1904) was enacted which puts the control and management of roads, bridges, and landings in the hands of the county supervisors. They are to locate and maintain roads, and for the purpose may take any necessary lands by due legal process. They are to levy annually a county tax not exceeding 40 cents on $100 for certain road uses and also a magisterial district tax not exceeding 40 cents on $100 for certain road uses. If the levy exceeds 30 cents on $100 the question whether such a tax shall be levied must be submitted to a vote of the people. They are to appoint in January, biennially, a road superintendent who shall be a civil engineer or a person well versed in road building. This superintendent is to keep the roads in order, and with certain restrictions may take material from private property for the purpose. Bond issues for road improvement are provided for. Upon petition of a majority of county supervisors the circuit court may order an election on the question of such bond issue and if three-fifths of the qualified voters, including three-fifths of the freeholders, are for it, the bonds are to be issued and a tax levied to pay them. But the bonded indebtedness is not to be made so large that the interest charge will require a yearly tax exceeding 20 cents on $100. The courts, upon application of the road supervisors, are to send the jail prisoners to work on the roads. The circuit court may grant authority to build a tram road not over 6 feet wide along any public road. The supervisors may macadamize any road, and may take possession of and maintain any turnpike abandoned by its owners. An amendment (chap. 42, 1904) provides for the continuance of tolls on turnpikes and fixes the rates.

IRRIGATION AND DRAINAGE INVESTIGATIONS, 1904.

By ELWOOD MEAD, *Chief, Irrigation and Drainage Investigations, Office of Experiment Stations.*

The work of the United States Department of Agriculture in irrigation and drainage is under the direction of the Office of Experiment Stations, and is carried out very largely in cooperation with State experiment stations and State engineers. Several States have made appropriations to cover a part of the cost of this cooperative work. California appropriated $10,000 for two years' work; Utah, $10,000 for two years' work; Nevada, $2,000 for two years' work, and in Nebraska, $5,000 for two years' work.

STUDY OF METHODS OF APPLICATION OF WATER.

The fundamental purpose of the work is improvement in farming with the aid of irrigation, and the principal effort has been directed to the working out of improved methods. The first subject taken up was the quantity of water used in general practice, this data to serve as a basis for future study. From the first the work has gradually tended toward more scientific investigations to determine the exact water requirements of crops and to work out systems of distribution and methods of application which will help to limit the use of water to the quantity required. The limited water supply of the arid region makes this work of great importance, since the extension of the irrigated area depends very largely upon a more economical use of water.

During the season of 1904 measurements of the quantity of water used in ordinary practice were made in the Modesto and Turlock districts in California, in the Lost River Valley, Oregon, in the Yakima Valley, Washington, and in the Raft River Valley, Idaho. A scientific study of the water requirements of crops was carried on in California, Washington, Nevada, and New Mexico.

In California experiments were carried on to work out methods of checking losses from evaporation when water is applied to the land. It was found that when water was applied in furrows 3 inches deep, 13 per cent less water was lost than when the surface was flooded and that when the water was applied in furrows 12 inches deep there was a saving of 25 per cent over flooding.

At a number of State stations experiments were carried on to determine the quantity of water which would produce the largest return from various crops, but the results have not been tabulated.

The cost and adaptability of the various methods of applying water to land were studied in all parts of the arid region. The check method was found well adapted to lands having an even slope of from 3 to 15 feet per mile, seeded to grains and grasses. Preparing the land for this system of irrigation is expensive, but applying water after the land has been prepared is cheaper than by any other method. Flooding also is used with grains and grasses. For this little preparation of the land is necessary, but applying the water is more expensive than with checks, since an even distribution of the water requires constant attention.

Furrow irrigation is found to be best for all cultivated crops. The top soil is not wet, so that losses by evaporation are greatly reduced and the land can be sooner cultivated, still further reducing losses by evaporation. This method is not expensive and allows of the use of a smaller stream than flooding or checks, but it requires more time in applying water. The basin method, which is used for orchards, requires a great deal of work in preparing for applying the water, but a large stream can be used and the work of irrigation done quickly.

PREPARING LAND FOR IRRIGATION.

The success of irrigation farming depends very largely upon the proper preparation of the land. This consists in the removing of brush, leveling the ground, and building of laterals. Reports from all sections of the arid region show the average cost of this work to be as shown in the following table:

Cost of preparing land for irrigation.

	Cost.
Removing sagebrush	$1.50 to $5
Leveling the land	1.00 to 15
Building laterals, etc	1.00 to 15
Total	3.50 to 35

THE SEMIARID REGIONS.

There is a wide belt of land east of the Rocky Mountains extending from Mexico to Canada where crops can be raised in occasional years without irrigation, where cattle raising is the principal industry. Climatic conditions make either agriculture or live-stock raising more or less uncertain. This Office is making a study of this region for the purpose of working out a system of agriculture which will relieve this uncertainty so far as possible. Experiments in dry farming are being carried on, but it is believed that the best results can be secured by a combination, having a small irrigated area on which crops will be assured even in dry years and a larger area in dry farming where crops can be secured during wet years. A large part of this land is beyond the reach of water from streams and the supply must be secured either by storing the storm waters or pumping. During 1904 the work in this field consisted in the collection of information regarding the cost of pumping and the efficiency of various kinds of pumps, windmills, and engines. The following table shows the average cost of windmills of different sizes, the average areas served by them, and the cost per acre. This table is the average for a large number of plants and represents the results secured in operation, not theoretical capacities.

Cost of windmills.

Size of mill.	Cost.	Area served.	Cost per acre.
Feet.		*Acres.*	
8	$90	1.23	$73.17
10	120	3.08	38.96
12	150	5.07	29.59

The annual cost of maintenance for 43 mills on the acreage basis was $2.35 per acre served.

Data collected in California, Arizona, and Texas show the fuel cost of pumped water in these States to be as follows:

Fuel cost of pumped water.

State.	Acre-foot lifted 1 foot.	Average lift, in feet.	Cost at ground surface.
California, 17 plants	$0.066	78.2	$5.16
Arizona, 8 plants	.053	37.1	1.97
Texas, 20 plants	.043	40.0	1.72

The same data as to the fuel cost of raising water, averaged on the basis of the quantity of water lifted by the individual plants, is given in the following table:

Fuel cost of raising 1 acre-foot of water 1 foot.

	Cost.
General average	$0.030
Pumps discharging less than 1 cubic foot per second	.094
Pumps discharging 1 cubic foot per second and less than 5	.049
Pumps discharging 5 cubic feet per second and less than 10	.025
Pumps discharging 10 cubic feet per second or more	.023

This table brings out the great advantage of establishing large plants wherever possible. This can be brought about by establishing one plant for several farms, rather than a separate plant for each farm.

The following table gives the average discharges of centrifugal pumps of different sizes and the areas which can be served by these pumps on the basis of the average quantities of water used on the various crops, as reported for pumping plants in Texas:

Discharges of pumps of different sizes and areas served.

Size of pump.	Discharge.	Areas served.	
		Alfalfa or truck.	Corn.
Inches.	*Galls. per minute.*	*Acres.*	*Acres.*
3	221	44	55
4	387	77	97
5	540	108	135
6	896	179	224
10	4,185	837	1,046
12	5,157	1,030	1,289
30	24,975	4,997	6,244

At the University of California a laboratory was established for testing the operation of pumps of various kinds and sizes to determine the conditions under which they give the best results. These tests show that each pump has a definite head and speed, at which it gives the best results. They show also that centrifugal pumps give the best results where the suction head is lowest, showing that pumps should be placed as near as possible to the water supply.

RICE IRRIGATION.

Records of the quantities of water used in rice irrigation in Louisiana and Texas for the past four years show that the tendency is toward using smaller quantities of water, as it is found that deep water prevents the proper warming of the soil by the sun's rays and produces spindling plants which are easily blown down.

The great extension of the area devoted to rice along the Gulf coast has exhausted the supply of fresh water in the streams, and the question of the advisability of using brackish water has arisen. It is found that salt water injures young rice, but helps rice which is well along in its growth. It was feared, however, that the continued use of the salt water might bring about such an accumulation of salt in the soil as to injure the lands, but no permanent injury to the land has so far resulted. In the past season no difference could be observed in the yield of land which had received salt water in previous years and that of land which had received only fresh water. Heavy rains and the use of fresh water during seasons when the supply is ample apparently wash out the salt. In the Mermentau River a dam has been built to hold up the fresh water during the wet season and to keep out salt water when the stream is low. The season of 1904 was the first in which this dam was in use and its operation is believed to have saved the rice crop of 1904 along the Mermentau. It is probable that the same plan could be adopted on the other streams along the Gulf coast to great advantage.

The success of the rice industry in Louisiana and Texas has led to experiments in rice farming in Arkansas. This Office, in cooperation with the Arkansas Experiment Station, established an experimental station near Lonoke, Ark., to determine the feasibility of raising rice on the prairie lands of Arkansas which have not been successfully farmed in any other crop. The experiments show an ample water supply at a depth of 70 feet. The cost of sinking an 8-inch well to a depth of 114 feet was $4 per foot. A full statement of the cost and expenses of operation is not yet available. Another plant in the same neighborhood serving 70 acres cost, for the well and machinery, $27.39 per acre served, and the expense of operation for the season of 1904, including interest on the investment, was $19.21 per acre served. The yield was 74.6 bushels per acre.

CRANBERRIES.

Success in cranberry culture depends to a large extent upon the control of the water supply. In the cranberry marshes of Wisconsin frost is liable to occur at any time during the picking season, and water is used as a protection. The experiments of the past season show that on cold nights the temperature is higher over sanded bog where all unnecessary vegetation has been removed and over well-drained bog than over ordinary matted bog. However, these measures only lessen the danger. Flooding is the one sure method of prevention. When frost is expected the vines are wet or submerged, and when the danger is passed the water must be immediately drained off or the berries may be injured. The work at the experimental station is to determine the proper methods of handling water to get it on and off of the bogs as quickly as possible.

PORTO RICO.

In cooperation with the Porto Rico Experiment Station experiments are being made in irrigation of truck, sugar cane, and rice. The experiments in irrigation of sugar cane are being made in cooperation with the sugar planters of the island.

DRAINAGE.

The drainage work of the Department includes the study of the problems which relate to the draining of individual farms and the larger problems of draining whole districts. This work includes both the engineering features and the forms of organization which are best adapted to the larger drainage projects.

In the West waste water from irrigation and leakage from ditches have caused a rise of ground water which has swamped large areas and caused an accumulation of alkali which has rendered large areas unproductive. At a number of stations wells were put down and measurements made to determine the rate of the rise of this ground water, to secure a basis for computing the capacities of drains and to determine the direction from which the excess water is coming, making it possible in many instances to put in intercepting ditches which will carry off the seepage water before it reaches the lands which have been injured. Where this can be done it is not necessary to use underdrains in the injured land, but where the water can not be intercepted it must be removed by underdrainage.

In the East the object of drainage is usually to remove surplus water coming from rainfall or overflowed streams. The reclamation of overflowed areas along the Missouri, Illinois, and Wabash rivers was studied during the past season. In some cases it was found possible to relieve the land by straightening natural-drainage channels so that they would be able to carry the flood flow instead of overflowing the bottom lands. In other cases it was found necessary to build levees surrounding the lands to be reclaimed, thus keeping out flood waters, and put in pumping plants to relieve the land of the surplus water from seepage. Along the Illinois River mistakes in the construction of levees have been the cause of the failure of many drainage districts. It is recommended that in the construction of levees the foundations be cleared of all stumps and other vegetable matter and that a muck ditch be put in under the levee. It was also found that in general practice levees were not high enough and the slopes were too steep. It is recommended that no slopes be made steeper than 3 to 1.

In cooperation with the Iowa State College tests were made to determine the relative cost of putting in tile drains by machinery and by hand. It was found that the putting in of the tile drains, including the digging of the ditches, on a field of 320 acres, by machinery, cost $149.44, and that this work done by hand would have cost $196.20, a saving of 23 per cent by the use of machinery. The use of a machine was not recommended for individual farmers, as the investment is considerable and the operation of the machine requires practice and skill. It is, however, recommended for contractors for this class of work, as they could keep the machine in use a large part of the time and have it operated by men who devote their time to it.

LAWS AND INSTITUTIONS.

Irrigation from the Platte River and its tributaries from an interstate standpoint has been studied for the past two years and a report of this work is now ready for publication. This report is a study of the laws and decisions of the three States, Colorado, Wyoming, and Nebraska. The courts of both Nebraska and Wyoming have declared for the recognition of priorities regardless of State lines, while the courts of Colorado have not yet ruled on this question. This report gives complete tables of the rights established in the three States and discusses the physical conditions which influence their enforcement. Return seepage has greater influence than any other one physical condition upon the enforcement of water rights. Return seepage from the lands along the upper sections of the stream provides a supply for lower users, doing away with the necessity of turning down to them the entire flow of the stream where their rights are earlier than those above. There seems to be little likelihood of general conflict between water users in the different States, but on both branches of the Platte there will be opportunity for conflict between appropriators immediately above and below the State lines. At present the water users in the lower States have no means of protecting their rights except through the courts, and the principal need on these streams, from an interstate standpoint, is some officer or commission with interstate powers to distribute the water between the States. The same conditions exist on Raft River in Idaho and Utah, and there the need is the same.

The operation of the Idaho law of 1903 was studied on Raft River, Idaho. The chief difficulty encountered by the water master, who was also an agent of this Office, was the absence of proper measuring devices, and it is recommended that the laws for the putting in of these devices be amended in such a way that the expense of putting them in, if the owners of the ditches fail to do so, shall not fall upon the water master.

The most efficient systems of distribution of water under canals was under investigation in California in the Modesto and Turlock districts and in the vicinity of Imperial. The first step in working out a proper system of distribution for these districts was a measurement of the water delivered to consumers, and this has been provided for. The work will be continued through the coming year. In the Imperial Valley the farmers under the various laterals of the Imperial Canal system are organized into stock companies, and the same system is recommended for the Modesto and Turlock districts.

Seven States have created the office of State engineer and a report on the practical workings of the laws creating this office in these seven States has been prepared. It is the purpose of this study to compare the laws of the several States to detérmine which provisions have proved beneficial and which ones can be improved.

The development of the rice industry and the use of streams for irrigating rice in the comparatively humid States of Louisiana and Texas has called attention to the

necessity for some legislation on water rights in these States. The conditions in the rice district and the present State laws of Louisiana and Texas were studied during the season of 1904, and a report is in preparation discussing the needed legislation in these States.

DISPOSAL OF LAND BY THE GENERAL GOVERNMENT FOR IRRIGATION.

The law of August 18, 1894, known as the Carey Law, grants to each of the arid States 1,000,000 acres of land on condition of its reclamation. During the fiscal year ending June 30, 1904, land was applied for and segregated under the Carey Law, as follows: [a]

Operations under Carey Act in 1904.

States.	Number of projects.	Lands applied for.	Number of projects.	Lands in applications approved.	Number of projects.	Patents issued.
		Acres.		*Acres.*		*Acres.*
Colorado	1	1,381.27				
Idaho	2	111,130.77	2	24,241.22		
Montana			1	3,675.22	1	10,104.03
Oregon	5	17,783.60	2	28,284.83		
Wyoming	5	86,019.63	7	236,986.93	3	18,413.03

Under the the desert land law there were original entries of 753,731.33 acres, and final entries of 268,913.43 acres.

RECLAMATION SERVICE.

The act of Congress of June 17, 1902, known as the reclamation act, sets aside the proceeds from the disposal of public lands in certain States for examination, survey, and construction of irrigation works for the reclamation of arid and semiarid lands. The fund for this purpose at the end of the fiscal year ended June 30, 1904, was $23,012,836.46, and it is estimated that the addition to this fund for the next fiscal year will be $4,000,000. This money is tentatively allotted for surveys and construction work in the various States and Territories as shown by the following table. A portion of this money has already been expended in the works now underway, and in several of the States and Territories where feasible projects have not been selected the amount given is 51 per cent of the amount arising within that State which, under the law, must be expended in the State.

Allotment of reclamation funds. [b]

States and Territories.	Project.	Acres.	Estimate.	Authority.
Arizona	Salt River	160,000	$3,000,000	General estimates. [c]
California	Yuma	100,000	3,000,000	May 20, 1904.
Colorado	Uncompahgre	100,000	2,250,000	June 7, 1904.
Idaho	Minidoka	130,000	2,600,000	April 23, 1904.
Kansas	Pumping (?)	2,000	49,903	Restricted fund.
Montana	Milk River (?)	60,000	891,991	Do.
Nebraska	North Platte	100,000	1,000,000	May 3, 1904. [d]
Nevada	Truckee	200,000	3,000,000	General estimates. [c]
New Mexico	Hondo	10,000	240,000	November 10, 1903.
North Dakota	Fort Buford and pumping	60,000	1,737,111	Restricted funds. [e]
Oklahoma	Otter Creek	40,000	1,301,590	Do.
Oregon	Malheur	90,000	2,000,600	May 11, 1904.
South Dakota	Bellefourche	60,000	2,100,000	May 10, 1904.
Utah	Utah Lake	20,000	154,199	Restricted fund.
Washington	Palouse	100,000	1,395,035	Do.
Wyoming	Shoshone	100,000	2,250,000	February 10, 1904.
Total		1,332,000	26,970,429	

[a] Report of Commissioner of General Land Office, 1904, p. 33.
[b] Report of the Secretary of the Interior, 1904, p. 95.
[c] See letter of March 14, 1904, and quarterly estimates.
[d] For Pathfinder Reservoir in Wyoming; further details under survey.
[e] Fort Buford project heads in Montana; the sum of $1,200,000 set aside May 10, 1904.

EXTENT OF IRRIGATION IN THE UNITED STATES.

The following table, showing the extent of irrigation in the United States in 1902, is taken from Bulletin 16 of the Census Bureau:

Irrigation statistics for the United States.

Region, States, etc.	Acres irrigated.	Cost of systems.
United States	9,481,289	$92,731,594
Arid States	8,471,641	77,430,212
Arizona	247,250	4,688,298
California	1,708,720	23,772,157
Colorado	1,754,761	14,769,561
Idaho	713,595	6,190,071
Montana	1,140,694	5,576,975
Nevada	570,001	1,706,212
New Mexico	254,945	4,301,915
Oregon	439,981	2,089,609
Utah	713,621	7,303,607
Washington	154,962	2,330,738
Wyoming	773,111	4,701,049
Semiarid States	403,449	5,105,390
Kansas	28,922	599,098
Nebraska	245,910	2,463,748
North Dakota	10,384	45,087
Oklahoma	3,328	36,770
South Dakota	53,137	381,569
Texas[a]	61,768	1,579,118
Rice States	606,199	10,195,992
Georgia	8,581	274,990
Louisiana	387,580	4,747,359
North Carolina	3,422	112,905
South Carolina	38,220	1,343,104
Texas	168,396	3,717 634

[a] This excludes rice irrigation.

IRRIGATION CONSTRUCTION.

There are no records of irrigation construction. The activity in that line is shown to some extent by the records of filings of claims or applications in the States where such filings are recorded. The filing of a claim or application is not necessarily followed by construction, but the number of such filings is an index to the activity in such work.

Colorado.—In 1903-4 there were begun in Colorado 1,093 ditches having an aggregate capacity of 37,817 cubic feet per second. Filings were made for 392 reservoirs having a total aggregate capacity of 149,586,227 cubic feet.

Idaho.—Between March 11, 1903, when the new irrigation law became operative, and November 1, 1904, 1,285 applications for permits to use water were received and 900 permits issued for the diversion of 27,951.87 cubic feet of water per second for irrigation and domestic purposes, and 76,078.23 cubic feet per second for mining, power, transportation, and other nonconsuming purposes. These permits authorize the reclamation of 1,672,131.98 acres of land and a generation of 696,197.82 horsepower. Permits for 290.75 cubic feet of water per second for the irrigation of 15,513 acres have lapsed by failure of the holders to make proof of the application of water within the prescribed time, and for the same reasons permits to divert 100.36 cubic feet per second for power and other nonconsuming purposes to develop 262 horsepower have been canceled.

Nebraska.—During the year 1904, 37 applications were received, 29 of which were allowed, 7 dismissed, and 1 not yet acted upon.

Wyoming.—For the year ending August 31, 1904, there were received 1,448 applications for water. One hundred and forty of these were rejected or not returned after being corrected. There were approved 744 original applications, 208 applications for enlargements, 50 applications for reservoirs, and 106 combined reservoir and ditch applications.

PUBLICATIONS OF THE DEPARTMENT OF AGRICULTURE.

The publications of the United States Department of Agriculture are mainly of three general classes:

I. Publications issued annually, comprising the Yearbooks, the Annual Reports of the Department, the annual reports of the Bureau of Animal Industry, Weather Bureau, the Bureau of Soils, and the Office of Experiment Stations.

II. Other departmental reports, divisional bulletins, etc. Of these, each Bureau, Division, and Office has its separate series, in which the publications are numbered consecutively as issued. They comprise reports and discussions of a scientific or technical character.

III. Farmers' Bulletins, divisional circulars, reprinted Yearbook articles, and other popular papers.

The publications in Class I are distributed by the Department and by Senators and Representatives in Congress. For instance, of the 500,000 copies of the Yearbook usually issued, the Department receives only 30,000, while the remaining 470,000 copies are distributed by Members of Congress. The Department's supply of the publications of this class, being so limited, has to be reserved almost exclusively for distribution to special correspondents and in return for services rendered.

The publications of Class II are not for distribution by Members of Congress, and they are not issued in editions large enough to warrant free general distribution by the Department. The supply is used mainly for distribution to those who cooperate with the Department or render it some service, and to educational and other public institutions. A sample copy of this class of publications can usually be sent on application, but aside from this the Department generally finds it necessary to refer applicants to the Superintendent of Documents, of whom further mention is made below.

The publications of Class III treat in a practical way of subjects of particular interest to farmers. They are usually issued in large editions, and are for free general distribution by the Department. The Farmers' Bulletins are also for distribution by Senators and Representatives in Congress, to each of whom is furnished annually, according to law, a quota of several thousand copies for distribution among his constituents.

A limited supply of nearly all the publications in Classes I and II is, in compliance with the law, placed in the hands of the Superintendent of Documents for sale at cost of printing. Applications for these should be addressed to the Superintendent of Documents, Government Printing Office, Washington, D. C., and should be accompanied by postal money order payable to him for the amount of the price. No postage stamps nor private checks should be sent. The Superintendent of Documents is not permitted to sell more than one copy of any public document to the same person. The Public Printer may sell to one person any number not to exceed 250 copies if ordered before the publication goes to press. Under a recent resolution the Superintendent of Documents is permitted, with the approval of the head of any Department of the Government, to reprint any public document in numbers sufficient to supply the demand under the restriction of not more than one copy to the same person.

The Secretary of Agriculture has no voice in designating the public libraries which shall be depositories of public documents. Of the distribution of documents to such depositories, including the publications of this and all other Departments of the Government, the Superintendent of Documents has full charge.

For publications of the Weather Bureau, requests and remittances should be directed to the Chief of the Weather Bureau.

The Department has no list of persons to whom all publications are sent. A monthly list is issued on the first day of each month giving the titles of all publications issued during the previous month, with all the explanations necessary to enable applicants to order intelligently. This list will be mailed regularly to all who apply for it. The Department also issues and sends out to all who apply for them a complete list of all its publications printed for free distribution and a list of all the Department's publications for sale by the Superintendent of Documents.

STANDARDS FOR DAIRY PRODUCTS, 1904.

States.	Milk.			Skim milk.	Cream.	Butter.	Cheese.
	Total solids.	Solids not fat.	Fat.	Total solids.	Fat.	Fat.	Fat.
	Per cent.	*Per ct.*	*Per ct*	*Per ct.*	*Per ct.*	*Per cent.*	
United States [a]	[b] 12	8.5	3.25	9.25	18	82.5	Full cream, 50 p. c. of the total solids to be fat.
California	....	....	....	....	([c])	....	Full cream, 30 p. c. fat; half skim, 15 p. c. fat; skim from skim milk. Fancy excepted.
Colorado	....	....	....	....	....	....	Full cream, 35 p. c. total solids to be fat; skim, fat less than 35 p. c. of total solids.
Dist. of Columbia..	....	9	3.5	9.3	20	83 Not over 12 p. c. water or 5 p. c. salt.	
Georgia........	....	8.5	3.5	....	....	....	
Hawaii	11.5	....	2.5	....	....	....	
Idaho........	....	8	3	....	18	82.5	Full cream, 30 p. c. fat (fancy excepted); skim, less than 30 p. c. fat; less than 15 p. c. sale prohibited.
Illinois [d]........	....	....	3	....	[e] 15	80	Whole milk, 48 p. c. total solids to be fat.
Indiana	....	9	3	....	....	80 Maximum water 15 p. c.; salt, 6 p. c.	Skim, minimum fat 10 p. c
Iowa	12.5	....	3	....	15	....	
Kentucky	12	....	3	....	15	80	Skim, less than 10 p. c. fat.
Maine	12	....	3	....	....	....	
Maryland [f]	12.5	....	3.5	....	....	....	
Massachusetts.....	13	9.3	3.7	9.3	....	....	
April-September	12	9	3	....	....	....	
Michigan........	12.5	....	3	....	....	....	
Minnesota........	Sp. grav. 1.029-33 13	....	3.5	Sp. grav. 1.032-37	[g] 20	Maximum water, 16 p. c.	Full cream, 45 p. c. total solids to be fat; skim, fat less than 45 p. c. of total solids.
Missouri........	....	....	....	....	....	....	Full cream, from milk with 3 p. c. fat; skim from milk less than 3 p. c. fat.
Montana	12	9	3	9 p. c. solids not fat.	15	....	
Nebraska........	....	....	3	....	15	....	
New Hampshire...	13	9.5	3.5	9	....	....	
April and Sept ..	12	....	3	....	....	....	
New Jersey........	12	....	....	....	....	....	
New York [h]........	12	....	3	....	....	....	Skim, from skim milk.
North Carolina [i]...	12	8.5	3.25	....	18	82.5	Full cream, 50 p. c. total solids to be fat; skim, from skim milk; cream cheese, milk 6 p. c. minimum fat.
North Dakota	12	....	3	....	15	....	Skim, from skim milk.
Ohio [h]	12	....	3	....	....	80	Full cream, 30 p. c. fat; skim, less than 30 p. c. fat.
Oregon	12	9	3	9 Sp. grav. 1.038	20	Not over 14 p. c. water.	Full cream, 30 p. c. fat; half skim, 15 to 30 p. c.; quarter skim, 7½ to 15 p. c.; skim, less than 7½ p. c. Fancy excepted.

[a] Proclamation of Secretary of Agriculture, Cir. 10, Nov. 20, 1903.
[b] Condensed milk, 28 per cent milk solids, of which one-fourth must be fat.
[c] Cream containing thickener must be labeled.
[d] Condensed milk must contain not less than 8.5 per cent fat; evaporated cream containing less than 15 per cent fat must be labeled "an unsweetened condensed milk."
[e] Coffee cream shall contain at least 15 per cent fat, and whipping cream at least 22 per cent fat.
[f] Condensed milk must contain the equivalent of 12.5 per cent of milk solids in crude milk of which 3.5 per cent shall be fats.
[g] No thickener allowed.
[h] In New York, Ohio, and Wyoming the milk solids of condensed milk must be in quantity the equivalent of 12 per cent of milk solids in crude milk of which solids 2.5 per cent shall be fat.
[i] Condensed milk must contain 28 per cent milk solids and 7 per cent fat.

Standards for dairy products, 1904—Continued.

States.	Milk.			Skim milk.	Cream.	Butter.	Cheese.
	Total solids.	Solids not fat.	Fat.	Total solids.	Fat.	Fat.	Fat.
	Per cent.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per cent.*	
Pennsylvania	12		3	8			Full cream, 32 p. c. fat; three-fourths cream, 24 p. c. fat; one-half cream, 16 p. c. fat; one-fourth cream, 8 p. c. fat; skim, below 8 p. c. fat. Fancy, less than 5 pounds, excepted.
Porto Rico	12		3			80 Maximum water, 16 p. c.; salt, 6 p. c.	Full cream, 30 p. c. fat; one-half skim, 15 p. c. fat; skim, 10 p. c.
Rhode Island	12		2.5				
South Carolina		8.5	3				
South Dakota	13		3		20	80.	Full cream, 45 p. c. solids to be fat; skim, fat less than 45 p. c.
Utah	12.5		3	9 p. c. solids not fat.	20	83	Skim, 7 to 11 inches in diameter; minimum height, 9 inches.
Vermont	12.5	9.25					
May and June	12						
Washington		8	3		18		Full cream, 30 p. c. fat; skim, 15 p. c. fat. Fancy excepted.
Wisconsin			3				Skim, 10 inches in diameter, 9 inches height.
Wyoming[a]	12		2.4			80	Skim, less than 20 p. c. fat.
May and June	11.5						

[a] In New York, Ohio, and Wyoming the milk solids of condensed milk must be in quantity the equivalent of 12 per cent of milk solids in crude milk of which solids 2.5 shall be fat.

FARMERS' INSTITUTES.

Farmers' institutes were held during the year ended June 30, 1904, in all of the States and Territories excepting Arkansas, South Dakota, Wyoming, Alaska, Indian Territory, and Porto Rico. The following table gives a summary of the work for the year:

Statistics of farmers' institutes for season ended June 30, 1904.

States and Territories.	Meetings.					Speakers on State force.	Funds for institutes.		Reports of proceedings.		Methods of distribution.
	Total number.	One day.	Two days or more.	Number of sessions.	Total attendance.		Appropriated year ended June 30, 1904.	Appropriated year ended June 30, 1905.	Published.	Number of copies.	
Alabama	24	24		49	3,639	9	$600	$600	No.		
Alaska[a]											
Arizona	1		1	15	600	3	50		No.		
Arkansas[a]											
California	113	62	51	380	43,680	20	7,234	7,234	Yes.	12,500	Agricultural journals and State report.
Colorado	15	11	4	36	1,660	11	517		No.		
Connecticut	18	18		36	2,500	29	200		Yes.	5,000	
Delaware	18	18		42	3,436	14	750	750	Yes.	5,000	
Florida	15	14	1	32	1,605	19			Yes.	3,000	
Georgia	34	32	2	68	7,000	8	1,000	1,000	Yes.	2,000	
Hawaii	4	4		8	200	9	30		Yes.	1,000	
Idaho	17		17	74	3,100	11	1,000	1,000	Yes.	5,000	By mail.
Illinois	105		105	609	84,681	82	18,173	17,650	Yes.	20,000	
Indiana	175	10	165	832	59,189	46	10,000	10,000	Yes.	600	Annual report State board of agriculture.

[a] No institutes held.

Statistics of farmers' institutes for season ended June 30, 1904—Continued.

States and Territories.	Meetings.					Speakers on State force.	Funds for institutes.		Reports of proceedings.		Methods of distribution.
	Total number.	One day.	Two days or more.	Number of sessions.	Total attendance.		Appropriated year ended June 30, 1904.	Appropriated year ended June 30, 1905.	Published.	Number of copies.	
Indian Territory[a]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
Iowa	70	.....	70	[b]350	[b]17,750	.....	7,425	7,425	No	.....	
Kansas	58	30	28	.....	14,432	19	2,000	2,000	No	.....	
Kentucky	4	.....	4	8	1,200	13	500	5,000	Yes	8,000	Supplements to agricultural journals.
Louisiana	39	39	.....	79	12,000	16	2,000	2,000	Yes	3,000	Mailing lists and institutes.
Maine	37	37	.....	79	5,473	20	2,500	2,500	Yes	6,000	State reports.
Maryland	23	.....	23	71	3,250	16	4,000	6,000	Yes	.....	Abstract mailed.
Massachusetts	104	104	.....	125	11,039	78	1,530	2,700	No	.....	
Michigan	292	218	74	812	52,236	54	9,825	9,325	Yes	9,000	Through institutes.
Minnesota	154	129	25	378	46,210	13	18,000	18,000	Yes	30,000	Institute annual.
Mississippi	107	105	2	214	11,326	17	1,725	3,000	No	.....	By experiment stations.
Missouri	147	141	6	311	30,220	26	5,000	5,000	Yes	7,000	
Montana	44	40	4	81	4,500	18	4,000	4,000	Yes	5,000	At institutes and through mails.
Nebraska	96	43	53	330	25,097	26	6,000	6,000	No	.....	
Nevada	4	3	1	10	453	6	83	.....	Yes	1,000	
New Hampshire	18	16	2	38	3,400	16	1,588	1,500	Yes	2,000	
New Jersey	30	15	15	119	4,500	10	1,800	1,800	No	.....	
New Mexico	4	3	1	9	160	9	28	.....	No	.....	
New York	267	100	167	1,154	64,347	63	20,000	20,000	Yes	25,000	By State director and legislature.
North Carolina	35	31	4	71	8,411	10	850	1,400	Yes	27,000	
North Dakota	46	23	23	151	13,567	10	4,000	4,000	Yes	10,000	At institutes and through mails.
Ohio	245	.....	245	1,225	75,360	33	16,747	16,750	Yes	20,000	Agricultural societies and institute officers.
Oklahoma	52	28	24	129	5,200	8	1,000	300	No	.....	
Oregon	14	8	6	46	4,500	9	350	500	No	.....	
Pennsylvania	204	59	145	805	70,380	58	20,500	20,500	Yes	31,600	By legislature and Department of Agriculture.
Porto Rico[a]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
Rhode Island	12	12	.....	21	1,260	12	600	.....	Yes	2,500	
South Carolina	33	32	1	.....	8,690	10	600	600	No	.....	
South Dakota[a]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
Tennessee	72	20	52	[b]200	8,300	6	5,000	5,000	No	.....	
Texas	144	140	4	178	15,130	16	3,950	15,130	Yes	10,000	
Utah	59	56	3	65	12,000	10	1,500	1,500	Yes	5,000	By mail.
Vermont	48	48	.....	125	10,000	24	5,000	5,000	Yes	3,000	Do.
Virginia	[b]50	[b]50	.....	[b]100	[b]10,000	6	3,500	[b]3,500	.....	.....	
Washington	57	12	45	259	15,922	12	2,500	2,500	No	.....	
West Virginia	97	20	77	386	12,095	23	4,556	.....	Yes	10,000	Newspapers.
Wisconsin	101	.....	101	512	52,000	25	12,000	12,000	Yes	60,000	
Wyoming[a]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
Total	3,306	1,755	1,551	10,622	841,698	953	210,211	223,164		329,200	

[a] No institutes held.   [b] Estimated.

PUBLIC LANDS OPEN FOR SETTLEMENT.

The figures given in the table below show the location of the public lands in the United States still open for occupation under the homestead and other laws for acquisition of titles by individuals. In general, the lands noted in the column "Area surveyed" are available for immediate private occupation under any of the laws now in force for grant of title by the Government. The lands scheduled as "Unsurveyed" must, of course, be surveyed before a grant can be made. The column head "Area appropriated" indicates roughly to what extent the section where the lands are located is already settled and under cultivation. The greater portion of the vacant land is in the timbered regions of the Southern States, the Lake region, and the Pacific coast, and the mountainous and arid regions of the Far West. The portion of lands cultivable without clearing or irrigation is comparatively small.

Applications for and information regarding public lands should be addressed to the registers and receivers of the United States district land offices in the cities and towns noted in the table. Full information should be obtained before any move is made toward occupation of these lands.

The total amount of land disposed of by the Government in the fiscal year ended June 30, 1904, was 16,405,821.95 acres; and the gross receipts in payment for it, $9,283,341.98, of which approximately $6,826,253.59 was turned over to the fund for the reclamation of arid lands.

Lands open for settlement, and location of land offices in the United States, June 30, 1904.

[Abridged from Report of Commissioner of General Land Office.]

State and location of office.	Area unappropriated.		Area appropriated.
	Area surveyed.	Area unsurveyed.	
ALABAMA.	*Acres.*	*Acres.*	*Acres.*
Huntsville a	85,390		7,806,210
Montgomery	134,340		24,580,500
ARIZONA.			
Prescott	6,230,224	18,547,015	3,251,605
Tucson	5,834,569	16,359,785	2,289,942
ARKANSAS.			
Camden	530,047		7,982,893
Dardanelle	879,453		3,290,047
Harrison	616,800		4,624,200
Little Rock	401,557		15,216,123
CALIFORNIA.			
Eureka	364,150	188,934	2,313,333
Independence	8,759,926	3,607,331	745,080
Los Angeles	9,050,884	2,405,044	6,147,043
Marysville	686,495	170,955	4,123,447
Redding	2,290,108	242,524	4,707,816
Sacramento	416,888	4,380	2,381,947
San Francisco	3,200,154	136,999	10,857,614
Stockton	361,439	27,747	4,762,573
Susanville	2,344,891	254,412	1,993,204
Visalia	602,255	98,277	5,905,291
COLORADO.			
Akron	730,369		2,287,131
Del Norte	1,546,081	516,060	1,903,299
Denver	3,737,991	390,323	5,923,146
Durango	2,905,797	468,611	732,292
Glenwood Springs	5,863,129	1,265,040	1,482,234
Gunnison	1,729,149	532,006	447,765
Hugo	1,685,342		1,785,658
Lamar	3,168,869		1,903,131
Leadville	1,396,877	301,995	697,988
Montrose	3,283,592	618,268	717,348
Pueblo	4,736,479	6,240	5,329,102
Sterling	949,378		2,013,122
FLORIDA.			
Gainesville	997,777	160,070	33,895,534
IDAHO.			
Blackfoot	2,205,324	2,672,722	4,822,160
Boise	4,011,843	7,108,504	1,782,262
Cœur d'Alene	505,389	2,308,364	1,605,018
Hailey	3,268,909	12,529,276	1,283,952
Lewiston	857,384	4,200,921	2,069,835
KANSAS.			
Colby	82,480		7,438,360
Dodge City	639,378		15,515,162
Wakeeney a	225,784		6,102,936
LOUISIANA.			
Natchitoches	66,775	65,018	3,884,361
New Orleans	35,398		23,535,374

a Land office discontinued since issuance of report for 1904.

Lands open for settlement, and location of land offices in the United States, etc.—Cont'd.

State and location of office.	Area unappropriated.		Area appropriated.
	Area surveyed.	Area unsurveyed.	
MICHIGAN.	*Acres.*	*Acres.*	*Acres.*
Marquette	340,507	....	36,358,039
MINNESOTA.			
Cass Lake	278,750	....	2,504,550
Crookston	943,760	350,400	7,042,680
Duluth	1,008,300	533,798	7,188,742
St. Cloud	12,400	....	28,987,880
MISSISSIPPI.			
Jackson	92,420	....	29,592,700
MISSOURI.			
Boonville	48,380	....	26,252,620
Ironton	71,090	....	9,925,910
Springfield	72,211	....	7,425,629
MONTANA.			
Bozeman	2,062,518	1,608,012	3,548,190
Greatfalls	7,133,502	7,383,420	3,569,298
Helena	2,286,585	4,538,572	3,032,754
Kalispel	194,771	3,576,907	2,002,416
Lewiston	2,948,189	2,779,893	2,291,000
Miles City	3,348,531	14,147,185	2,461,444
Missoula	434,927	4,012,423	1,616,617
NEBRASKA.			
Alliance	2,384,732	....	3,472,466
Brokenbow	1,842,879	....	2,183,801
Lincoln	667	....	11,858,613
McCook[a]	132,749	....	5,740,251
North Platte	557,238	....	3,868,083
O'Neill	553,575	....	8,081,425
Sidney	307,778	....	2,958,382
Valentine	2,043,171	....	2,510,641
NEVADA.			
Carson City	30,833,050	30,417,530	3,102,651
NEW MEXICO.			
Clayton	6,580,010	415,464	1,751,684
Lascruces	13,194,135	5,422,386	1,466,238
Roswell	7,817,500	5,810,913	2,310,354
Santa Fe	10,531,961	2,479,971	13,292,079
NORTH DAKOTA.			
Bismarck	4,815,105	3,215,036	8,985,359
Devils Lake	147,420	....	5,487,980
Fargo	42,000	....	7,915,070
Grand Forks	5,420	....	4,169,860
Minot	2,785,150	87,320	4,567,670
OKLAHOMA.			
Alva	38,477	....	1,676,430
Elreno	6,233	....	2,636,636
Guthrie	90	....	3,447,880
Kingfisher	84,346	....	4,335,864
Lawton	15,354	....	1,511,606
Mangum	13,605	....	2,093,410
Woodward	1,937,322	....	3,865,998
OREGON.			
Burns	4,042,631	1,386,719	1,861,723
Lagrande	1,700,859	159,222	4,291,422
Lakeview	4,941,547	3,242,240	2,666,908
Oregon City	361,955	127,716	5,740,509
Roseburg	864,193	451,909	7,135,637
The Dalles	2,616,104	279,159	4,512,020

[a] Land office discontinued since issuance of report for 1904.

Lands open for settlement, and location of land offices in the United States, etc.—Cont'd.

State and location of office.	Area unappropriated.		Area appropriated.
	Area surveyed.	Area unsurveyed.	
SOUTH DAKOTA.	*Acres.*	*Acres.*	*Acres.*
Aberdeen	62,800	....	3,251,448
Chamberlain	1,515,542	....	1,883,845
Huron	31,600	....	4,343,625
Mitchell	1,080	....	7,167,920
Pierre	1,274,616	....	1,772,895
Rapid City	7,527,474	306,831	2,668,675
Watertown	299	....	5,171,701
UTAH.			
Salt Lake City	11,560,475	28,142,991	5,087,495
WASHINGTON.			
North Yakima	459,778	707,660	2,587,649
Olympia	45,462	102,200	2,811,550
Seattle	61,639	196,414	3,856,058
Spokane	542,723	1,778,001	5,052,635
Vancouver	231,100	156,470	3,501,950
Walla Walla	512,900	274,859	2,376,950
Waterville	2,155,352	1,638,374	2,301,825
WISCONSIN.			
Ashland	27,600	....	3,019,067
Eau Claire	20,533	....	14,197,176
Wausau	23,240	....	17,554,740
WYOMING.			
Buffalo	6,240,521	768,897	1,312,121
Cheyenne	8,557,917	65,261	3,090,632
Douglas	7,422,952	226,998	858,050
Evanston	5,678,304	1,377,625	2,632,074
Lander	1,783,200	171,071	955,415
Sundance	4,637,432	....	1,143,725

METHOD OF ESTIMATING THE YIELD OF COTTON IN THE FIELD.

By J. C. Crawford, *Special Agent Bureau of Entomology.*

To estimate the yield of cotton from the plants in the field the following directions will be found useful: Determine the average number of sound bolls per plant by counting the number of such bolls on some five adjacent plants in at least three separate places in the field and dividing the total number of bolls counted in this manner by the total number of plants examined. Where the field is very large, or contains different soils, more than three places should be selected for counting. In the first column of the following table find the distance between the plants in the field, the crop of which is to be estimated. Then refer to the number on the same line in the following column headed by the size of bolls to which the variety planted belongs. Dividing the average number of bolls per plant in the field by the number found in this manner in the table will give the fraction of a bale per acre that will be produced. Example: If, in the case of a small boll variety like the King, the average number of bolls per plant is found to be 10, and the plants are chopped to a distance of 2 feet in rows 4 feet apart, the amount of the prospective yield per acre will be 10 divided by 25.4, or 0.39 of a bale. In using this table due allowance must be made for poor stands.

Number of cotton bolls per plant of various classes required at certain distances to produce a bale per acre when cotton gins 33⅓ per cent of lint.

Distance between plants, in feet.	Number of plants per acre.	Large bolls, 50 to 65 per pound.	Medium-sized bolls, 70 to 80 per pound.	Small bolls, 85 to 100 per pound.
1 × 3	14,520	5.9	7.7	9.5
1 × 4	10,890	7.9	10.3	12.7
1 × 5	8,712	9.8	12.9	15.9
1 × 6	7,260	11.8	15.4	19.1
1½ × 3	9,680	8.9	11.6	14.0
1½ × 4	7,260	11.8	15.4	19.1
1½ × 5	5,808	14.8	19.3	23.8
1½ × 6	4,840	17.8	23.2	28.6
2 × 2	10,890	7.9	10.3	12.7
2 × 3	7,260	11.8	15.4	19.1
2 × 4	5,445	15.8	20.6	25.4
2 × 5	4,356	19.7	25.8	31.8
2 × 6	3,630	23.2	30.9	38.4
3 × 3	4,840	17.8	23.2	28.6

The following classification of sqme of the principal varieties of cotton according to the size of the bolls, taken from Bulletin 107, Alabama Agricultural Experiment Station, page 192, will assist in the use of the table:

Large Boll Cottons, 50–65 per pound of seed cotton: Chase Improved, Texas Stormproof, Drake, Strickland, Banks, Russell, Lee Improved, Japan, Christopher Improved, Culpepper, Peerless, Thrash Select, Truitt, Jones Improved, Ellis, Duncan, Scroggins Prolific, Nancy Hanks, Maddox, Cummings, Sprueill, Coppedge, Griffin.

Medium-sized Boll Cottons, 70–80 per pound of seed cotton: Texas Bur, Smith Improved, Jackson Limbless, Herndon Select, W. A. Cook, Doughty, Big Boll, Minor, Texas Oaks, Mattis, Hawkins, Hawkins Jumbo, Hilliard, Pinkerton, Petit Gulf, Allen Improved, Bur.

Small Boll Cottons, 85–100 per pound of seed cotton: King, Parker, Wellborn, Tyler, Limb Cluster, Borden Prolific, Wise, Peterkin, Dickson, Boyd Prolific, Shine Early, Dearing, Norris, Bates Poor Land, Excelsior, Sea Island.

STATISTICS OF THE PRINCIPAL CROPS.[a]

CORN.

Corn crop of countries named, 1899–1903.

Countries.	1899.	1900.	1901.	1902.	1903.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States	2,078,144,000	2,105,103,000	1,522,520,000	2,523,648,000	2,244,177,000
Canada (Ontario)	22,356,000	27,947,000	25,621,000	21,159,000	30,211,000
Mexico	93,438,000	92,204,000	93,459,000	78,099,000	90,000,000
Total North America	2,193,938,000	2,225,254,000	1,641,600,000	2,622,906,000	2,364,388,000
Chile	9,000,000	8,000,000	9,000,000	9,000,000	9,000,000
Argentina	66,185,000	55,612,000	98,842,000	84,018,000	148,422,000
Uruguay	6,000,000	3,035,000	5,576,000	5,060,000	5,289,000
Total South America	81,185,000	66,647,000	113,418,000	98,078,000	162,711,000
France	25,548,000	22,232,000	26,393,000	24,928,000	25,000,000
Spain	25,629,000	26,016,000	25,759,000	25,272,000	18,759,000
Portugal	16,000,000	16,000,000	15,000,000	16,000,000	14,000,000
Italy	88,536,000	83,286,000	100,455,000	71,028,000	88,990,000
Austria	14,583,000	15,446,000	17,535,000	13,462,000	16,056,000
Hungary	115,981,000	127,656,000	127,389,000	104,546,000	135,751,000
Croatia-Slavonia	14,680,000	18,691,000	20,469,000	15,255,000	23,918,000
Total Austria-Hungary	145,244,000	161,793,000	165,393,000	133,263,000	175,725,000

[a] The figures in the following tables were furnished by the Bureau of Statistics, Department of Agriculture, except such as otherwise credited. All prices are on gold basis.

Corn crop of countries named, 1899–1903—Continued.

Countries.	1899.	1900.	1901.	1902.	1903.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Roumania	27,721,000	85,047,000	116,945,000	68,447,000	89,272,000
Bulgaria and E. Roumelia	20,462,000	18,000,000	25,000,000	18,109,000	20,000,000
Servia	25,938,000	18,472,000	18,849,000	18,396,000	19,479,000
Russia	30,912,000	34,256,000	68,400,000	48,647,000	50,732,000
Total Europe	405,990,000	465,102,000	562,194,000	424,090,000	492,957,000
Algeria	349,000	350,000	350,000	350,000	350,000
Egypt	30,000,000	25,000,000	30,000,000	30,000,000	30,000,000
Cape Colony	2,858,000	2,000,000	2,000,000	2,000,000	2,000,000
Total Africa	33,207,000	27,350,000	32,350,000	32,350,000	32,350,000
Australasia	9,780,000	10,025,000	10,168,000	7,847,000	5,615,000

RECAPITULATION BY CONTINENTS.

North America	2,193,938,000	2,225,254,000	1,641,600,000	2,622,906,000	2,364,388,000
South America	81,185,000	66,647,000	113,418,000	98,078,000	162,711,000
Europe	405,990,000	465,102,000	562,194,000	424,090,000	492,957,000
Africa	33,207,000	27,350,000	32,350,000	32,350,000	32,350,000
Australasia	9,780,000	10,025,000	10,168,000	7,847,000	5,615,000
Total	2,724,100,000	2,794,378,000	2,359,730,000	3,185,271,000	3,058,021,000

Visible supply of corn in the United States and Canada, first of each month for ten years.[a]

Month.	1895–1896.	1896–1897.	1897–1898.	1898–1899.	1899–1900.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	10,762,000	11,199,000	21,501,000	32,983,000	21,551,000
August	5,770,000	13,246,000	20,018,000	25,430,000	17,687,000
September	6,819,000	18,608,000	37,528,000	24,043,000	11,070,000
October	6,760,000	17,800,000	45,412,000	30,132,000	16,662,000
November	6,338,000	23,913,000	52,980,000	33,198,000	18,738,000
December	7,381,000	22,635,000	49,559,000	25,870,000	17,555,000
January	9,164,000	26,457,000	48,292,000	26,936,000	19,024,000
February	17,035,000	29,725,000	53,522,000	36,726,000	20,110,000
March	17,040,000	33,764,000	52,457,000	44,792,000	28,340,000
April	19,290,000	32,670,000	52,228,000	43,618,000	31,883,000
May	13,239,000	21,707,000	34,734,000	34,236,000	30,416,000
June	11,231,000	16,161,000	28,288,000	19,070,000	18,289,000

Month.	1900–1901.	1901–1902.	1902–1903.	1903–1904.	1904–1905.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	19,087,000	21,522,000	8,541,000	13,410,000	12,362,000
August	18,613,000	19,648,000	9,013,000	11,715,000	10,073,000
September	8,766,000	19,476,000	3,823,000	9,487,000	8,014,000
October	11,106,000	21,215,000	4,607,000	15,063,000	10,703,000
November	11,061,000	19,137,000	4,229,000	12,147,000	5,119,000
December	12,791,000	16,599,000	4,552,000	9,817,000	5,445,000
January	14,313,000	16,825,000	9,345,000	9,547,000	15,351,000
February	21,950,000	17,197,000	11,535,000	12,807,000	19,721,000
March	27,538,000	15,270,000	15,180,000	16,669,000	16,752,000
April	28,947,000	13,540,000	16,901,000	16,571,000	16,124,000
May	24,544,000	9,093,000	9,454,000	13,253,000	....
June	21,904,000	6,317,000	7,039,000	7,572,000	....

[a] These figures represent stocks available at 62 of the principal points of accumulation east of the Rocky Mountains, stocks in Manitoba elevators, and stocks afloat on lakes and canals, as reported by Bradstreet's.

Condition of the corn crop of the United States, monthly, 1890–1904.

Year.	July.	Aug.	Sept.	Oct.	Year.	July.	Aug.	Sept.	Oct.	Year.	July.	Aug.	Sept.	Oct.
1890	93.1	73.3	70.1	70.6	1895 ...	99.3	102.5	96.4	95.5	1900 ...	89.5	87.5	80.6	78.2
1891	92.8	90.8	91.1	92.5	1896 ...	92.4	96.0	91.0	90.5	1901 ...	81.3	54.0	51.7	52.1
1892	81.1	82.5	79.6	79.8	1897 ...	82.9	84.2	79.3	77.1	1902 ...	87.5	86.5	84.3	79.6
1893	93.2	87.0	76.7	75.1	1898 ...	90.5	87.0	84.1	82.0	1903 ...	79.4	78.7	80.1	80.8
1894	95.0	69.1	63.4	64.2	1899 ...	86.5	89.9	85.2	82.7	1904 ...	86.4	87.3	84.6	83.9

Acreage, production, value, prices, and exports of corn of the United States, 1866–1904.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1.	Farm value, Dec. 1.	Chicago cash price per bushel, No. 2. December. Low.	December. High.	May of following year. Low.	May of following year. High.	Domestic exports, including corn meal, fiscal years beginning July 1.
	Acres.	*Bush.*	*Bushels.*	*Cents.*	*Dollars.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Bushels.*
1866	34,306,538	25.3	867,946,295	47.4	411,450,830	53	62	64	79	16,026,947
1867	32,520,249	23.6	768,320,000	57.0	437,769,763	61	65	61	71	12,493,522
1868	34,887,246	26.0	906,527,000	46.8	424,056,649	38	58	44	51	8,286,665
1869	37,103,245	23.6	874,320,000	59.8	522,550,509	56	67	73	85	2,140,487
1870	38,646,977	28.3	1,094,255,000	49.4	540,520,456	41	59	46	52	10,676,873
1871	34,091,137	29.1	991,898,000	43.4	430,355,910	36	39	38	43	35,727,010
1872	35,526,836	30.8	1,092,719,000	35.3	385,736,210	27	28	34	39	40,154,374
1873	39,197,148	23.8	932,274,000	44.2	411,961,151	40	49	49	59	35,985,834
1874	41,036,918	20.7	850,148,500	58.4	496,271,255	64	76	53	67	30,025,036
1875	44,841,371	29.5	1,321,069,000	36.7	484,674,804	40	47	41	45	50,910,532
1876	49,033,364	26.2	1,283,827,500	34.0	436,108,521	40	43	43	56	72,652,611
1877	50,369,113	26.7	1,342,558,000	34.8	467,635,230	41	49	35	41	87,192,110
1878	51,585,000	26.9	1,388,218,750	31.7	440,280,517	30	32	33	36	87,884,892
1879	53,085,450	29.2	1,547,901,790	37.5	580,486,217	39	43¼	32⅞	36⅛	99,572,329
1880	62,317,842	27.6	1,717,434,543	39.6	679,714,499	35⅝	42	41½	45	93,648,147
1881	64,262,025	18.6	1,194,916,000	63.6	759,482,170	58½	63½	69	76⅞	44,340,683
1882	65,659,545	24.6	1,617,025,100	48.5	783,867,175	49¼	61	53¼	56¾	41,655,653
1883	68,301,889	22.7	1,551,066,895	42.4	658,051,485	54¼	63½	52½	57	46,258,606
1884	69,683,780	25.8	1,795,528,432	35.7	640,735,859	34½	40¼	44¾	49	52,876,456
1885	73,130,150	26.5	1,936,176,000	32.8	635,674,630	36	42¾	34¼	36¾	64,829,617
1886	75,694,208	22.0	1,665,441,000	36.6	610,311,000	35¾	38	36⅞	39⅜	41,368,584
1887	72,392,720	20.1	1,456,161,000	44.4	646,106,770	47	51⅛	54	60	25,360,869
1888	75,672,763	26.3	1,987,790,000	34.1	677,561,580	33½	35⅞	33⅛	35⅜	70,841,673
1889	78,319,651	27.0	2,112,892,000	28.3	597,918,829	29¼	35	32¾	35	103,418,709
1890	71,970,763	20.7	1,489,970,000	50.6	754,433,451	47¾	53	55	69½	32,041,529
1891	76,204,515	27.0	2,060,154,000	40.6	836,439,228	39⅜	59	40¾	a100	76,602,285
1892	70,626,658	23.1	1,628,464,000	39.4	642,146,630	40	42⅞	39½	44½	47,121,894
1893	72,036,465	22.5	1,619,496,131	36.5	591,625,627	34¼	36½	36¾	38½	66,489,529
1894	62,582,269	19.4	1,212,770,052	45.7	554,719,162	44¾	47½	47¾	55½	28,585,405
1895	82,075,830	26.2	2,151,138,580	25.3	544,985,534	25	26¾	27½	29½	101,100,375
1896	81,027,156	28.2	2,283,875,165	21.5	491,006,967	22½	23¾	23	25½	178,817,417
1897	80,095,051	23.8	1,902,967,933	26.3	501,072,952	25	27½	32⅜	37	212,055,543
1898	77,721,781	24.8	1,924,184,660	28.7	552,023,428	33⅛	38	32½	34⅝	177,255,046
1899	82,108,587	25.3	2,078,143,933	30.3	629,210,110	30	31½	36	40½	213,123,412
1900	83,320,872	25.3	2,105,102,516	35.7	751,220,034	35¼	40½	42⅝	58½	181,405,473
1901	91,349,928	16.7	1,522,519,891	60.5	921,555,768	62½	67½	59⅛	64¾	28,028,688
1902	94,043,613	26.8	2,523,648,312	40.3	1,017,017,349	43¾	57¼	44	46	76,639,261
1903	88,091,993	25.5	2,244,176,925	42.5	952,868,801	41	43¾	47¼	50	58,222,061
1904	92,231,581	26.8	2,467,480,934	44.1	1,087,461,440	43½	49	......	......	....

a Coincident with "corner."

The preceding table shows that the greatest area in corn, 94,043,613 acres, was reported in 1902; the greatest production, 2,523,648,312 bushels, in the same year; the greatest farm value on December 1, $1,087,461,440, in 1904; the greatest average yield per acre, 30.8 bushels, in 1872; the greatest average farm price per bushel, 63.6 cents in 1881. For the five years, 1900–1904, the average area was 89,807,597 acres; the average production, 2,172,585,716 bushels; the average farm value on December 1, $946,024,678; the average yield per acre, 24.2 bushels; the average farm price per bushel on December 1, 43.5 cents.

Acreage, production, value, and distribution of corn of the United States in 1904, by States.

States and Territories.	Crop of 1904.			Stock in farmers' hands March 1, 1905.		Shipped out of county where grown.
	Acreage.	Production.	Value.			
	Acres.	*Bushels.*	*Dollars.*	*Bushels.*	*Per cent.*	*Bushels.*
Maine	12,871	510,979	413,893	97,086	19	....
New Hampshire	27,597	753,398	542,447	180,816	24	....
Vermont	59,427	2,133,429	1,557,403	576,026	27	21,334
Massachusetts	44,355	1,596,780	1,149,682	463,066	29	47,903
Rhode Island	9,912	337,999	283,919	135,200	40	8,380
Connecticut	54,505	2,120,244	1,547,778	699,681	33	....
New York	625,615	17,079,290	10,930,746	4,782,201	28	341,586
New Jersey	274,999	10,449,962	6,060,978	4,388,984	42	1,985,493
Pennsylvania	1,427,522	48,535,748	28,636,091	16,016,797	33	2,912,145
Delaware	187,116	5,688,326	2,787,280	3,014,813	53	2,161,564
Maryland	635,146	21,213,876	10,606,938	9,758,383	46	7,212,718
Virginia	1,841,198	42,899,913	25,310,949	20,591,958	48	5,147,990
North Carolina	2,677,992	40,705,478	25,237,396	20,759,794	51	2,035,274
South Carolina	1,789,503	22,189,837	15,532,886	11,982,512	54	1,109,492
Georgia	3,977,707	47,334,713	33,607,646	24,614,051	52	1,893,389
Florida	620,592	6,640,334	4,980,250	3,187,360	48	199,210
Alabama	2,791,811	41,877,165	25,126,299	22,194,897	53	1,256,315
Mississippi	2,079,040	39,709,664	22,237,412	21,046,122	53	1,985,483
Louisiana	1,369,771	27,258,443	15,537,313	10,358,208	38	545,169
Texas	6,048,792	136,702,699	71,085,403	49,212,972	36	19,138,378
Arkansas	2,237,621	48,332,614	25,616,285	19,333,046	40	1,933,305
Tennessee	3,235,601	80,890,025	40,445,012	33,973,810	42	16,986,905
West Virginia	757,961	19,176,413	12,272,904	6,328,216	33	958,821
Kentucky	3,227,345	86,815,580	42,539,634	26,462,544	42	10,417,870
Ohio	3,065,494	99,628,555	45,829,135	33,873,709	34	20,921,997
Michigan	1,293,373	36,990,468	19,235,043	9,987,426	27	2,589,333
Indiana	4,552,281	143,396,852	58,792,709	53,056,835	37	40,151,119
Illinois	9,428,320	344,133,680	134,212,135	123,888,125	36	154,860,156
Wisconsin	1,519,189	45,119,913	20,755,160	12,182,377	27	2,255,996
Minnesota	1,554,241	41,809,083	15,051,270	12,124,634	29	2,926,636
Iowa	9,295,683	303,039,266	100,002,958	127,276,492	42	63,638,246
Missouri	5,783,307	151,522,643	66,669,963	48,487,246	32	9,091,359
Kansas	6,440,654	134,609,669	55,189,964	44,421,191	33	18,845,354
Nebraska	7,955,559	260,942,335	86,110,971	112,205,204	43	122,642,897
South Dakota	1,560,678	43,855,052	15,787,819	14,033,617	32	8,771,010
North Dakota	90,308	1,914,530	765,812	344,615	18	38,291
Montana	3,902	86,624	58,904	23,388	27	....
Wyoming	2,218	72,085	41,088	17,300	24	....
Colorado	117,837	2,415,658	1,304,455	603,914	25	120,783
New Mexico	34,281	778,179	606,980	171,199	22	23,345
Arizona	6,091	144,966	131,919	20,295	14	1,450
Utah	11,468	380,738	274,131	76,148	20	....
Idaho	5,346	156,638	109,647	23,496	15	3,133
Washington	9,815	242,430	160,004	33,940	14	4,849
Oregon	17,212	495,706	302,381	49,571	10	4,957
California	54,415	1,556,269	1,213,890	280,128	18	280,128
Oklahoma	1,729,953	48,611,679	18,958,555	17,986,321	37	9,236,219
Indian Territory	1,685,957	54,625,007	21,850,003	22,942,503	42	16,933,752
Total	92,231,581	2,467,480,934	1,087,461,440	954,268,217	38.7	551,634,734

Average yield per acre of corn in the United States, 1895–1904, by States.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	42.0	37.0	37.0	40.0	36.0	36.0	39.4	21.7	30.2	39.7
New Hampshire	40.2	42.0	34.0	41.0	39.0	37.0	38.5	23.3	21.0	27.3
Vermont	45.6	41.0	35.0	43.0	36.0	40.0	40.0	21.8	23.4	35.9
Massachusetts	43.9	43.0	32.5	40.0	36.0	38.0	40.5	31.3	24.0	36.0
Rhode Island	30.9	34.0	31.0	34.0	31.0	32.0	32.1	28.4	30.1	34.1
Connecticut	37.9	38.0	31.5	37.0	39.0	38.0	39.0	31.5	22.4	38.9
New York	35.6	34.0	31.0	33.0	31.0	32.0	33.0	25.0	25.0	27.3
New Jersey	33.0	33.0	31.5	37.0	39.0	33.0	36.9	34.5	24.0	38.0
Pennsylvania	33.5	40.0	36.0	37.0	32.0	25.0	35.0	36.1	31.2	34.0
Delaware	21.0	22.0	29.0	25.0	22.0	24.0	30.0	28.0	27.5	30.4
Maryland	26.8	32.0	33.0	31.0	32.0	26.0	34.2	32.4	28.7	33.4
Virginia	18.6	21.5	18.0	22.0	20.0	16.0	22.2	22.0	21.8	23.3
North Carolina	14.5	12.0	13.0	14.0	13.0	12.0	12.0	13.9	14.7	15.2
South Carolina	11.1	9.0	9.0	10.0	9.0	7.0	6.9	10.4	10.3	12.4
Georgia	13.0	11.0	11.0	9.0	10.0	10.0	10.0	9.0	11.7	11.9
Florida	11.2	10.0	8.0	9.0	10.0	8.0	9.0	8.6	9.9	10.7
Alabama	15.9	12.5	12.0	15.0	12.0	11.0	10.9	8.4	14.8	15.0
Mississippi	15.8	13.5	14.5	18.0	16.0	11.0	10.9	11.5	18.4	19.1

Average yield per acre of corn in the United States, 1895–1904, by States—Continued.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Louisiana	18.8	13.0	17.0	18.0	18.0	17.0	13.7	12.5	20.6	19.9
Texas	26.4	9.5	18.5	25.0	18.0	18.0	11.6	8.1	24.2	22.6
Arkansas	21.5	13.5	16.0	20.0	20.0	19.0	8.1	21.3	20.9	21.6
Tennessee	25.0	23.0	21.0	26.0	20.0	20.0	14.2	21.9	23.5	25.0
West Virginia	24.2	30.0	24.5	29.0	26.0	27.0	23.0	26.5	22.6	25.3
Kentucky	31.2	28.0	23.0	31.0	21.0	26.0	15.6	27.0	26.6	26.9
Ohio	32.6	41.0	32.5	37.0	36.0	37.0	26.1	38.0	29.6	32.5
Michigan	33.8	38.0	31.5	34.0	25.0	36.0	34.5	26.4	33.5	28.6
Indiana	32.8	35.0	30.0	36.0	38.0	38.0	19.8	37.9	33.2	31.5
Illinois	37.4	40.5	32.5	30.0	36.0	37.0	21.4	38.7	32.2	36.5
Wisconsin	31.8	37.0	33.0	35.0	35.0	40.0	27.4	28.2	29.3	29.7
Minnesota	31.2	30.5	26.0	32.0	33.0	33.0	26.3	22.8	28.3	26.9
Iowa	35.1	39.0	29.0	35.0	31.0	38.0	25.0	32.0	28.0	32.6
Missouri	36.0	27.0	26.0	26.0	26.0	28.0	10.1	39.0	32.4	26.2
Kansas	24.3	28.0	18.0	16.0	27.0	19.0	7.8	29.9	25.6	20.9
Nebraska	16.1	37.5	30.0	21.0	28.0	26.0	14.1	32.3	26.0	32.8
South Dakota	11.1	26.0	24.0	28.0	26.0	27.0	21.0	18.9	27.2	28.1
North Dakota	21.3	35.0	17.0	19.0	23.0	16.0	22.6	19.4	25.2	21.2
Montana	25.0	26.0	18.0	28.0	23.0	15.0	25.0	22.0	24.1	22.2
Wyoming	27.5	25.0	12.0	16.0	22.0	34.0	39.5	19.8	19.4	32.5
Colorado	20.7	16.0	19.0	18.0	17.0	19.0	17.1	16.5	19.8	20.5
New Mexico	27.2	16.0	27.0	21.0	20.0	22.0	31.6	22.0	24.0	22.7
Arizona	......	......	......	......	......	......	18.0	20.2	22.4	23.8
Utah	20.3	25.0	22.0	21.0	20.0	20.0	19.4	20.1	21.4	33.2
Idaho	......	......	......	......	......	......	23.0	24.7	34.5	29.3
Washington	17.1	14.0	18.0	12.0	23.0	20.0	17.5	23.0	23.1	24.7
Oregon	26.4	22.0	25.0	24.0	22.0	23.0	20.8	23.4	25.8	28.8
California	34.5	37.0	31.5	26.0	27.0	25.0	31.0	30.5	30.7	28.6
Oklahoma	......	......	......	......	19.0	26.0	7.3	25.8	23.3	28.1
Indian Territory	......	......	......	......	......	......	12.0	24.9	27.7	32.4
General average	26.2	28.2	23.8	24.8	25.3	25.3	16.7	26.8	25.5	26.8

Average value per acre of corn in the United States, based upon farm value December 1, 1895–1904, by States.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Maine	$22.68	$17.39	$17.39	$19.20	$18.00	$19.80	$29.94	$16.06	$19.93	$32.16
New Hampshire	20.50	18.90	15.30	18.86	19.11	20.72	30.03	17.01	13.23	19.66
Vermont	21.89	15.58	15.05	18.92	16.92	20.00	29.20	14.82	14.51	26.21
Massachusetts	22.83	19.78	15.28	19.60	18.36	20.52	30.78	23.16	15.84	25.92
Rhode Island	17.30	16.66	16.74	21.76	16.43	21.44	24.40	22.15	24.38	28.64
Connecticut	19.33	15.96	15.43	19.24	19.50	20.90	29.25	23.31	15.01	28.40
New York	16.02	12.92	12.40	14.19	13.95	15.04	23.76	16.75	15.00	17.47
New Jersey	13.86	11.88	11.97	14.80	15.60	14.85	24.35	19.32	13.68	22.04
Pennsylvania	13.07	13.20	22.24	14.80	13.12	11.25	21.70	20.94	17.78	20.06
Delaware	7.14	5.50	8.70	7.75	7.48	9.12	17.10	13.72	13.48	14.90
Maryland	9.92	10.24	9.90	10.85	11.52	10.66	19.84	16.52	14.64	16.70
Virginia	6.88	6.88	6.84	7.70	7.60	7.84	13.10	11.44	11.55	13.75
North Carolina	5.51	4.44	5.59	6.02	6.11	6.84	8.76	8.34	8.97	9.42
South Carolina	5.11	4.14	4.41	4.60	4.50	4.48	5.80	7.18	7.11	8.68
Georgia	5.33	4.73	5.28	4.32	5.00	5.70	8.20	6.57	8.07	8.45
Florida	5.26	5.30	4.40	4.50	5.30	4.80	7.65	6.62	7.23	8.02
Alabama	5.88	5.63	5.52	6.15	5.64	6.38	8.39	5.63	8.44	9.00
Mississippi	5.85	5.94	6.53	7.02	7.36	6.38	8.07	7.02	9.94	10.70
Louisiana	7.24	5.85	7.65	7.38	7.92	8.50	10.27	8.25	11.95	11.34
Texas	8.18	3.90	7.58	8.50	6.48	8.46	9.28	5.35	11.62	11.75
Arkansas	6.88	4.99	6.40	5.80	7.60	8.17	6.56	10.44	10.66	11.45
Tennessee	6.75	6.44	7.56	7.54	7.80	9.80	9.23	10.29	11.52	12.50
West Virginia	9.68	10.20	9.80	10.73	11.70	13.50	14.95	14.31	14.46	16.19
Kentucky	8.42	7.00	8.05	8.37	7.77	10.40	9.52	11.34	14.90	13.18
Ohio	8.80	8.61	8.12	9.99	10.80	12.58	14.88	15.96	13.91	14.95
Michigan	10.82	9.12	8.50	11.56	9.00	13.32	17.94	13.73	15.41	14.87
Indiana	7.54	6.65	6.30	9.00	10.26	12.16	10.89	13.64	11.95	12.91
Illinois	8.23	7.29	6.83	7.50	9.36	11.84	12.20	13.93	11.59	14.23
Wisconsin	9.54	8.14	8.25	9.80	10.50	13.20	14.25	14.10	12.60	13.66
Minnesota	6.24	5.79	6.24	7.68	7.92	9.57	11.83	9.12	10.75	9.68
Iowa	6.32	5.46	4.93	8.05	7.13	10.26	13.00	10.56	10.64	10.76
Missouri	7.20	5.40	6.24	7.02	7.80	8.96	6.77	12.87	11.02	11.53
Kansas	4.62	5.04	3.96	4.16	6.75	6.08	4.91	10.17	9.22	8.57
Nebraska	2.90	4.88	5.10	4.62	6.44	8.06	7.61	9.69	7.28	10.82
South Dakota	2.55	4.68	5.04	6.44	6.76	7.83	9.45	7.75	9.52	10.12
North Dakota	5.11	8.75	5.44	6.84	7.59	6.72	10.40	8.73	10.58	8.48
Montana	18.75	15.50	11.70	18.48	11.96	8.85	22.50	15.84	14.94	15.10
Wyoming	15.67	19.50	6.00	8.80	9.46	20.40	28.44	11.68	11.25	18.52

Average value per acre of corn in the United States, based upon farm value December 1, 1895–1904, by States—Continued.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Colorado	$8.49	$5.76	$7.22	$7.20	$7.31	$9.12	$12.65	$9.73	$10.69	$11.07
New Mexico	15.23	8.80	15.66	11.76	11.60	14.08	24.33	17.16	18.00	17.71
Arizona	......	......	......	......	......	......	16.20	20.40	20.16	21.66
Utah	9.95	12.75	12.10	12.60	11.80	12.60	17.46	13.47	14.98	23.90
Idaho	......	......	......	......	......	......	13.80	15.31	19.67	20.51
Washington	6.84	7.98	9.90	5.04	12.65	11.80	10.15	14.95	12.70	16.30
Oregon	14.52	12.32	13.25	14.40	14.08	13.11	11.86	15.44	17.29	17.57
California	18.29	19.61	17.64	16.12	16.20	15.25	21.08	23.49	22.72	22.31
Oklahoma	......	......	......	......	3.80	6.76	5.55	10.06	8.85	10.96
Indian Territory	......	......	......	......	......	......	9.12	10.71	10.80	12.96
General average	6.64	6.06	6.26	7.10	7.66	9.02	10.09	10.81	10.82	11.79

Average farm price of corn per bushel in the United States, December 1, 1895–1904, by States.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	54	47	47	48	50	55	76	74	66	81
New Hampshire	51	45	45	46	49	56	78	73	63	72
Vermont	48	38	43	44	47	50	73	68	62	73
Massachusetts	52	46	47	49	51	54	76	74	66	72
Rhode Island	56	49	54	64	53	67	76	78	81	84
Connecticut	51	42	49	52	50	55	75	74	67	73
New York	45	38	40	43	45	47	72	67	60	64
New Jersey	42	36	38	40	40	45	66	56	57	58
Pennsylvania	39	33	34	40	41	45	62	58	57	59
Delaware	34	25	30	31	34	38	57	49	49	49
Maryland	37	32	30	35	36	41	58	51	51	50
Virginia	37	32	38	35	38	49	59	52	53	59
North Carolina	38	37	43	43	47	57	73	60	61	62
South Carolina	46	46	49	46	50	64	84	69	69	70
Georgia	41	43	48	48	50	57	82	73	69	71
Florida	47	53	55	50	53	60	85	77	73	75
Alabama	37	45	46	41	47	58	77	67	57	60
Mississippi	37	44	45	39	46	58	74	61	54	56
Louisiana	40	45	45	41	44	50	75	66	58	57
Texas	31	41	41	34	36	47	80	66	48	52
Arkansas	32	37	40	29	38	43	81	49	51	53
Tennessee	27	28	36	29	39	49	65	47	49	50
West Virginia	40	34	40	37	45	50	65	54	64	64
Kentucky	27	25	35	27	37	40	61	42	56	49
Ohio	27	21	25	27	30	34	57	42	47	46
Michigan	32	24	27	34	36	37	52	52	46	52
Indiana	23	19	21	25	27	32	55	36	36	41
Illinois	22	18	21	25	26	32	57	36	36	39
Wisconsin	30	22	25	28	30	33	52	50	43	46
Minnesota	20	19	24	24	24	29	45	40	38	36
Iowa	18	14	17	23	23	27	52	33	38	33
Missouri	20	20	24	27	30	32	67	33	34	44
Kansas	19	18	22	26	25	32	63	34	36	41
Nebraska	18	13	17	22	23	31	54	30	28	33
South Dakota	23	18	21	23	26	29	45	41	35	36
North Dakota	24	25	32	36	33	42	46	45	42	40
Montana	75	60	65	66	52	59	90	72	62	68
Wyoming	57	78	50	55	43	60	72	59	58	57
Colorado	41	36	38	40	43	48	74	59	54	54
New Mexico	56	55	58	56	58	64	77	78	75	78
Arizona	75	......	......	......	......	......	90	101	90	91
Utah	49	51	55	60	59	63	90	67	70	72
Idaho	......	......	......	......	......	......	60	62	57	70
Washington	40	57	55	42	55	59	58	65	55	66
Oregon	55	56	53	60	64	57	57	66	67	61
California	53	53	56	62	60	61	68	77	74	78
Oklahoma	......	......	......	......	20	26	76	39	38	39
Indian Territory	......	......	......	......	......	......	76	43	39	40
General average	25.3	21.5	26.3	28.7	30.3	35.7	60.5	40.3	42.5	44.1

Freight rates, average for corn, in cents, St. Louis to New Orleans, by river.

Year.	Per bushel. Low water.	Per bushel. High water.	Year.	Per bushel. Low water.	Per bushel. High water.	Sacks, per 100 lbs.	Year.	Per bushel. Low water.	Per bushel. High water.	Sacks, per 100 lbs.	Year.	Sacks, per 100 lbs.
1869....	6.32	8.42	1877..	7.63	8.59	20.04	1886.....	5.00	7.00	16.00	1895.....	13.00
1870....	9.23	13.66	1878..	4.96	8.93	17.36	1887.....	5.00	7.00	18.25	1896.....	14.54
1871....	6.71	16.29	1879..	5.00	11.00	18.00	1888.....	5.00	7.50	15.00	1897.....	10.83
1872....	9.79	19.04	1880..	7.00	9.50	19.00	1889.....	5.00	7.00	17.93	1898.....	10.00
1873....	6.15	9.67	1881..	4.00	8.00	20.00	1890.....	5.00	7.00	15.66	1899.....	10.00
1874....	4.95	8.09	1882..	5.50	7.00	20.00	1891.....	5.00	7.50	16.28	1900.....	10.00
1875....	4.87	10.01	1883..	5.00	7.00	17.75	1892.....	5.00	7.00	16.87	1901.....	10.00
1876....	5.02	11.30	1884..	5.00	7.00	14.00	1893.....	....	....	17.54	1902.....	10.00
			1885..	5.00	7.00	15.00	1894.....	....	....	17.14	1903.....	10.00
											1904.....	(a)

[a] No shipment.

Freight rates, average for corn, in cents per bushel, Chicago to New York.

Year.	By lake and canal.[a]	By lake and rail.	By all rail.	Year.	By lake and canal.[a]	By lake and rail.	By all rail.
1875	....	11.34	19.50	1890..........	5.93	7.32	11.36
1876	8.75	9.68	14.12	1891..........	6.32	7.53	14.00
1877	9.59	13.42	18.03	1892..........	5.95	7.21	12.96
1878	8.83	10.45	16.39	1893..........	7.18	7.97	13.65
1879	10.49	12.20	14.56	1894..........	4.93	6.50	12.32
1880	13.41	14.43	17.48	1895..........	4.50	6.40	10.29
1881	7.77	9.42	13.40	1896..........	5.75	6.15	10.50
1882	6.72	10.28	13.50	1897..........	4.53	6.92	11.43
1883	8.03	11.00	15.12	1898..........	3.81	4.41	9.80
1884	6.55	8.50	12.32	1899..........	5.08	5.83	10.08
1885	6.30	8.01	12.32	1900..........	4.07	4.72	9.19
1886	8.45	11.20	14.00	1901..........	4.61	5.16	9.21
1887	8.50	11.20	14.70	1902..........	4.83	5.51	9.94
1888	6.71	10.26	13.54	1903..........	4.85	5.78	10.54
1889	6.32	8.19	12.60	1904..........	[b] 3.63	4.82	10.38

[a] Including Buffalo charges and tolls. [b] Exclusive of Buffalo charges.

Grain in Farmers' Hands, March 1, 1905.

The report of the Bureau of Statistics placed the estimate of corn in farmers' hands on March 1, 1905, about 954,000,000 bushels, or 38.7 per cent of last year's crop, against 37.4 per cent of the crop of 1903 on hand on March 1, 1904, and 41.6 per cent of the crop of 1902 on hand at the corresponding date in 1903.

The amount of wheat remaining in farmers' hands was about 111,000,000 bushels, or 20.1 per cent of last year's crop, as compared with the 20.8 per cent of the crop of 1903 on hand on March 1, 1904, and 24.5 per cent of the crop of 1902 on hand at the corresponding date in 1903.

Of oats there were reported to be about 347,000,000 bushels, or 38.8 per cent of last year's crop, still in farmers' hands, as compared with 34.9 per cent of the crop of 1903 on hand on March 1, 1904, and 36.9 per cent of the crop of 1902 on hand at the corresponding date in 1903.

Wholesale prices of corn per bushel in leading cities of the United States, 1899–1904.

Date.	New York.		Baltimore.		Cincinnati.		Chicago.		Detroit.		St. Louis.		San Francisco.	
	No. 2.		No. 2.		No. 2.		No. 2.		No. 2.		No. 2.		No. 1, white (per cwt.).	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1899.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*		
January	41⅜	45⅝	39½	41⅝	35½	38	35¼	38⅛	37	38	34¾	36¼	$1.12	$1.15
February	42¼	45	37¾	42	33	37	33½	37	35½	37	33	35	......	......
March	41	45⅛	36	39⅜	35	37½	33	36⅛	34½	36½	33	34¾	......	......
April	41	45½	38	43	36½	37½	34	35½	35½	37½	33½	35	1.15	1.17½
May	39¼	43½	36¾	38¾	34	36½	32½	34⅜	34½	35½	31½	34½	1.17½	1.17½
June	40⅛	42⅝	37	39½	35	36½	33¼	35½	34⅛	35	32	33½	1.15	1.17½
July	37⅜	41⅛	35	38¾	35	36½	31	34⅞	34	35½	31½	33½	1.15	1.15
August	36½	41¼	34¾	37½	32	34½	30½	33	33½	35	30	31½	1.10	1.12½
September	38⅝	41⅝	36½	40½	33¾	35	31¼	35	33¼	35½	30	31	1.07½	1.07½
October	39¾	42⅜	37½	39¼	34	36	31	33	34½	36½	30½	31¾	......	......
November	39⅝	41¾	37½	39¾	31½	35	30¾	33¼	33	35½	30	31½	......	......
December	39⅜	40⅞	36⅝	38⅜	31½	34	30	31½	32	33½	29½	31	1.05	1.05
1900.			Mixed.											
January	39⅞	42¼	36⅝	37¾	32¾	36	30½	31⅝	32½	34	30½	31	1.00	1.00
February	39⅞	44⅛	36¾	40⅜	33¼	36	31½	34¼	33½	35½	30⅛	33½	1.00	1.00
March	40⅞	46	38	42⅞	36	40¾	33⅜	38¼	36	40½	33½	37½	1.02½	1.10
April	45¾	49¾	42⅝	45½	41	43½	38¼	40⅞	40	43½	37½	39¾	1.07½	1.10
May	41	47⅛	40⅝	45	40½	44	36	40½	39¼	41	36⅞	40½	1.02½	1.07½
June	42¾	50⅝	41⅝	48	39¾	45	37⅜	43½	39¾	45	37	42	1.02½	1.17½
July	44	52⅛	42⅜	48	41⅛	47	38⅜	44¾	40¾	45	37½	43	1.17½	1.17½
August	42⅞	47¾	41¾	45	41	43	37¼	41¼	42½	43¾	37½	40	1.22½	1.30
September	45	50⅜	44¼	47	42½	44	38⅞	43¼	43½	44	38¾	40½	......	......
October	46	49¾	42	47	37	43	36½	41¾	41	43½	34	39	1.25	1.27½
November	45¾	47½	42¼	44½	37	40	35	49½	38¾	41	34¼	35¾	1.20	1.25
December	44¾	48	41⅞	44¼	37¾	39½	35¼	40½	38	39½	33¾	36	1.20	1.20
1901.														
January	45½	48½	41½	43¼	38	40	36	37¾	38	39½	35	37	1.12½	1.15
February	47½	49	42¼	45	39½	42¼	37¼	40	39¼	40½	37½	40	1.10	1.20
March	48¼	50½	44¼	48¼	41½	42¾	39	44	40	43	38¾	43	1.15	1.32½
April	48½	53¾	46⅛	49¾	44½	47	41	48	43	45½	41	46¼	1.15	1.35
May	49	56	46¾	50¼	43¼	46½	42⅝	58½	42¼	46	42	45⅝	1.20	1.35
June	46¼	49¾	44⅛	47¾	43½	44½	41	44⅜	42	45	41½	44	1.25	1.37½
July	50⅛	61¼	46¼	59	45	58	43½	58¼	44½	56½	43¾	60½	1.50	1.75
August	60	64	56½	63⅛	57½	64	53¾	59½	37	39½	55¼	63	1.65	1.70
September	61½	66⅛	59¼	62	56½	61½	51⅛	59¾	55¾	59½	55¾	60	1.55	1.65
October	60⅞	64	58¼	61	60	60½	54⅝	58	57½	60	57	61	1.62½	1.70
November	63½	69½	60¾	67	63	66	57⅛	63⅞	60	66½	60½	66½	1.40	1.60
December	69¼	72⅞	65	68	66½	71½	62½	67½	66½	70½	65½	70	1.30	1.40

Wholesale prices of corn per bushel in leading cities of the United States, 1899–1904—Continued.

Date.	New York.		Baltimore.		Cincinnati.		Chicago.		Detroit.		St. Louis.		San Francisco.	
	No. 2.		No. 2.		No. 2.		No. 2.		No. 2.		No. 2.		No. 1, white (per cwt.).	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1902.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*		
January	66	72¼	58½	69½	62	68½	56½	64½	57	67¼	59	69¼	$1.30	$1.45
February	66½	71¼	60¼	68½	61	64½	56⅝	61¼	59	62	58½	63	1.35	1.45
March	65	71½	63	68	62	64	56	61⅞	59	61½	59	63	1.35	1.42½
April	65½	73	63½	69	60½	67½	56¾	64⅛	59½	64½	59¾	67	1.40	1.45
May	66⅞	73	66½	70	64	67¼	59⅛	64¾	63¼	65½	62½	66	1.55	1.60
June	68¾	71½	67½	72	63½	66½	61	71½	63¼	66½	62	67	1.55	1.65
July	65¾	73	67	77	63½	69	56	88	66	67	61	66	1.52½	1.60
August	63½	69½	59	67	58	64	54	60	66	67	51	61½	1.45	1.60
September	67½	72½	64	69	60	63½	57	62½	55¾	59½	56½	60½	1.45	1.65
October	67½	70½	65	69	60	62½	55	61½	57½	60	56	58½	1.45	1.60
November	61½	67	47	68	45	60	52¾	58	60	66½	44½	49	1.42½	1.60
December	57	64	43½	55¼	44	50	43¾	57¼	66½	70½	40½	49½	1.47½	1.65
1903.														
January	55	68½	51½	60	43½	48½	43¾	48⅛	47	49	40	44½	1.30	1.40
February	55¾	59	52½	55	46	48	42½	45	47	48	41	44¾	1.30	1.37½
March	50⅞	56¼	47¾	52¾	41½	47	41⅜	45⅝	40½	47½	39	45	1.17½	1.35
April	51	53½	48½	52½	40	46	41¾	45¼	41½	45½	39½	42½	1.17½	1.27½
May	52¾	55	51	55½	45⅛	47¾	44	46	46½	48	41½	47½	1.17½	1.27½
June	56	60⅝	54½	59	48½	54	47¼	52	49½	55	48	55	1.20	1.30
July	56⅛	60	58½	61	50	53	49	53	51	55½	48	51¾	1.25	1,57½
August	58¼	60¼	58	60	52½	54½	50½	53	54½	55½	48	51½	1.55	1.57½
September	53¼	59¾	56	60	48	53	45¼	52¾	51	56½	45	50	1.47½	1.57½
October	51¼	54	53	55	45½	49	43½	46	47½	51½	41½	45	1.30	1.50
November	49¼	52⅜	46½	54½	45½	46	41⅜	44¾	46½	48½	41½	43¼	1.25	1.35
December	49½	53½	46¾	49¼	44½	46	41	43¾	44	48½	41½	45	1.25	1.35
1904.			Mixed.						No. 3.					
January	51½	56	49¼	50⅝	45½	46½	42¾	47½	42	44	43½	45½	1.27½	1.32½
February	53	63	49⅞	54½	45½	47½	46	54½	43½	46	44½	48½	1.25	1.35
March	54¼	57	50¼	52¾	46	51	49	56½	44½	46½	44	49¼	1.30	1.45
April	52¾	56	50⅛	52½	50½	54	46½	56⅞	48½	51½	48	51½	1.37½	1.45
May	55½	60	51½	54	51½	56½	47¼	50	51	52½	48	54	1.42½	1.45
June	47⅛	50½	50⅛	53¾	48	51	53¼	59½	48½	52	47	50½	1.40	1.47½
July	53½	55⅜	50½	53¼	48	53½	47¼	50	49	51½	48½	52¾	1.40	1.55
August	55⅜	62⅛	53½	58½	52½	57½	51¼	55¾	51½	57½	51½	55	1.40	1.55
September	56½	60¼	56½	58¾	55	57	51	54¾	53½	54½	51	54	1.50	1.55
October	55⅝	62¼	.....	.....	55½	59	50	57¼	52	58½	51½	54½	1.40	1.55
November	54⅞	69	53	55	56½	58½	50	58⅛	47½	60	48½	57	1.37½	1.55
December	53	54¾	49¾	52½	45½	52	43½	49	44½	47¾	42½	49	1.25	1.55

Monthly average prices of corn in Chicago.[a]

[Cents per bushel.]

Month.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
January	$42\frac{5}{8}$	$34\frac{7}{8}$	43	$26\frac{7}{8}$	$22\frac{9}{16}$	$27\frac{1}{8}$	$36\frac{11}{16}$	$31\frac{1}{16}$	$36\frac{7}{8}$	$60\frac{1}{2}$	$45\frac{15}{16}$	$45\frac{1}{8}$
February	42	$34\frac{11}{16}$	$42\frac{1}{2}$	$28\frac{7}{16}$	$22\frac{1}{2}$	$28\frac{15}{16}$	$35\frac{1}{4}$	$32\frac{7}{8}$	$38\frac{3}{4}$	$58\frac{15}{16}$	$43\frac{1}{4}$	$50\frac{1}{4}$
March	$40\frac{13}{16}$	$35\frac{1}{4}$	$44\frac{3}{8}$	$28\frac{5}{8}$	$23\frac{3}{4}$	$28\frac{11}{16}$	$34\frac{9}{16}$	$35\frac{13}{16}$	$41\frac{1}{2}$	$58\frac{3}{16}$	$43\frac{1}{2}$	$52\frac{3}{4}$
April	$40\frac{3}{4}$	$37\frac{7}{8}$	$46\frac{15}{16}$	$29\frac{5}{8}$	$24\frac{3}{16}$	$32\frac{1}{16}$	$34\frac{1}{4}$	$39\frac{9}{16}$	$44\frac{1}{2}$	$60\frac{5}{8}$	$43\frac{1}{2}$	$51\frac{11}{16}$
May	42	$37\frac{5}{8}$	$51\frac{5}{8}$	$28\frac{1}{8}$	$24\frac{1}{4}$	$34\frac{11}{16}$	$33\frac{7}{16}$	$38\frac{1}{4}$	$50\frac{9}{16}$	$61\frac{15}{16}$	45	$48\frac{5}{8}$
June	$39\frac{9}{16}$	$39\frac{15}{16}$	50	$27\frac{3}{8}$	$24\frac{7}{16}$	$32\frac{3}{8}$	$34\frac{5}{8}$	$40\frac{7}{16}$	$42\frac{13}{16}$	$66\frac{1}{4}$	$49\frac{5}{8}$	$48\frac{13}{16}$
July	$38\frac{11}{16}$	$43\frac{1}{2}$	$44\frac{5}{8}$	26	$26\frac{7}{16}$	$33\frac{5}{8}$	$32\frac{15}{16}$	$41\frac{9}{16}$	$50\frac{3}{8}$	72	51	$48\frac{5}{8}$
August	$38\frac{3}{16}$	$53\frac{1}{16}$	$40\frac{3}{8}$	$22\frac{3}{4}$	$29\frac{3}{8}$	$31\frac{3}{4}$	$31\frac{3}{4}$	$39\frac{1}{4}$	$56\frac{5}{8}$	57	$51\frac{3}{4}$	$53\frac{1}{8}$
September	$39\frac{1}{4}$	53	$33\frac{15}{16}$	$20\frac{7}{8}$	$29\frac{5}{8}$	$30\frac{1}{4}$	$33\frac{1}{8}$	$41\frac{7}{16}$	$56\frac{15}{16}$	$59\frac{3}{4}$	49	$52\frac{7}{8}$
October	39	$50\frac{11}{16}$	$30\frac{3}{8}$	$24\frac{1}{8}$	$26\frac{1}{2}$	$30\frac{13}{16}$	32	$39\frac{1}{8}$	$56\frac{15}{16}$	$58\frac{1}{4}$	$44\frac{3}{4}$	$53\frac{5}{8}$
November	$37\frac{3}{16}$	50	$28\frac{1}{4}$	$24\frac{1}{8}$	$26\frac{11}{16}$	$33\frac{1}{16}$	32	$42\frac{1}{4}$	$60\frac{1}{2}$	55	$43\frac{1}{16}$	$54\frac{1}{16}$
December	$35\frac{3}{8}$	$46\frac{1}{8}$	$25\frac{3}{4}$	$23\frac{1}{8}$	$26\frac{1}{4}$	$35\frac{9}{16}$	$30\frac{3}{4}$	$37\frac{7}{8}$	65	$50\frac{1}{2}$	$42\frac{3}{8}$	$46\frac{1}{4}$
Yearly average	$39\frac{11}{16}$	$43\frac{1}{16}$	$40\frac{1}{8}$	$25\frac{5}{8}$	$25\frac{9}{16}$	$31\frac{5}{8}$	$33\frac{7}{16}$	$38\frac{1}{4}$	$50\frac{1}{12}$	$59\frac{15}{16}$	$46\frac{1}{8}$	$50\frac{1}{4}$

[a] This table exhibits average cash prices for the past twelve years. The monthly prices are means between the lowest and highest prices for each month, and the yearly prices are the averages of the monthly averages.

WHEAT.

Wheat crop of countries named, 1900–1904.

Countries.	1900.	1901.	1902.	1903.	1904.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States	522,230,000	748,460,000	670,063,000	637,822,000	552,400,000
Ontario	31,265,000	22,118,000	26,904,000	22,583,000	13,030,000
Manitoba	13,436,000	52,094,000	54,750,000	41,381,000	40,397,000
Rest of Canada	9,000,000	16,000,000	17,000,000	20,000,000	23,000,000
Total Canada	53,701,000	90,212,000	98,654,000	83,964,000	76,427,000
Mexico	12,429,000	12,021,000	8,477,000	12,000,000	12,000,000
Total North America	588,360,000	850,693,000	777,194,000	733,786,000	640,827,000
Chile	12,000,000	9,000,000	12,000,000	13,000,000	13,000,000
Argentina	101,655,000	74,753,000	56,380,000	100,636,000	120,598,000
Uruguay	6,891,000	3,664,000	7,604,000	5,240,000	7,000,000
Total South America	120,546,000	87,417,000	75,984,000	118,876,000	140,598,000
Great Britain	54,299,000	54,111,000	58,463,000	49,144,000	38,043,000
Ireland	1,682,000	1,470,000	1,602,000	1,176,000	1,040,000
Total United Kingdom	55,981,000	55,581,000	60,065,000	50,320,000	39,083,000
Norway	300,000	300,000	265,000	307,000	300,000
Sweden	5,380,000	4,193,000	4,757,000	5,547,000	5,417,000
Denmark	3,604,000	942,000	4,528,000	4,461,000	4,000,000
Netherlands	4,671,000	4,231,000	5,105,000	4,258,000	4,300,000
Belgium	13,788,000	14,143,000	14,521,000	12,350,000	12,500,000
France	326,083,000	310,938,000	327,841,000	364,320,000	296,606,000
Spain	100,703,000	136,905,000	133,523,000	128,979,000	110,000,000
Portugal	8,000,000	10,000,000	10,400,000	8,000,000	4,000,000
Italy	133,741,000	164,587,000	159,000,000	179,200,000	150,400,000
Switzerland	4,200,000	4,400,000	4,200,000	4,000,000	4,000,000
Germany	141,139,000	91,817,000	143,315,000	130,626,000	139,803,000
Austria	40,929,000	44,027,000	49,655,000	46,198,000	53,646,000
Hungary	141,202,000	123,936,000	170,884,000	161,958,000	137,078,000
Croatia-Slavonia	11,035,000	10,693,000	12,017,000	14,664,000	10,274,000
Bosnia-Herzegovina	1,750,000	2,000,000	2,300,000	3,923,000	3,000,000
Total Austria-Hungary	194,916,000	180,656,000	234,856,000	226,743,000	203,998,000
Roumania	56,663,000	72,386,000	76,220,000	73,700,000	53,738,000
Bulgaria	27,000,000	24,000,000	34,642,000	38,581,000	42,000,000
Servia	8,135,000	8,102,000	11,409,000	10,885,000	9,186,000
Montenegro	220,000	200,000	200,000	200,000	200,000
Turkey in Europe	20,000,000	22,000,000	25,000,000	26,000,000	23,000,000
Greece	7,050,000	6,400,000	7,000,000	8,000,000	7,000,000

Wheat crop of countries named, 1900–1904—Continued.

Countries.	1900.	1901.	1902.	1903.	1904.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Russia proper	319,193,000	319,991,000	463,258,000	454,596,000	514,123,000
Poland	19,722,000	14,409,000	20,349,000	19,255,000	21,241,000
North Caucasus	56,948,000	67,232,000	77,069,000	77,941,000	81,132,000
Finland	159,000	140,000	79,000	150,000	150,000
Total Russia in Europe	396,022,000	401,772,000	560,755,000	551,942,000	616,646,000
Total Europe	1,507,596,000	1,513,553,000	1,817,602,000	1,828,419,000	1,726,177,000
Siberia	20,172,000	16,504,000	30,796,000	48,670,000	35,388,000
Central Asia	6,959,000	9,645,000	15,897,000	20,995,000	12,672,000
Transcaucasia	35,000,000	35,000,000	38,025,000	40,437,000	42,000,000
Total Russia in Asia	62,131,000	61,149,000	84,718,000	110,102,000	90,060,000
Turkey in Asia	30,000,000	30,000,000	35,000,000	33,000,000	33,000,000
Cyprus	1,447,000	1,943,000	1,181,000	812,000	2,283,000
Persia	16,000,000	15,200,000	13,600,000	16,000,000	16,000,000
British India	200,000,000	264,825,000	227,380,000	297,601,000	357,162,000
Japan	21,688,000	22,457,000	20,000,000	21,000,000	21,000,000
Total Asia	331,266,000	395,574,000	381,879,000	478,515,000	519,505,000
Algeria	23,000,000	23,000,000	33,804,000	30,000,000	26,087,000
Tunis	4,872,000	4,428,000	4,127,000	7,523,000	10,519,000
Egypt	13,000,000	12,000,000	12,000,000	11,000,000	12,000,000
Cape Colony	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000
Total Africa	42,872,000	41,428,000	51,931,000	50,523,000	50,606,000
West Australia	1,018,000	799,000	963,000	1,017,000	1,935,000
South Australia	8,720,000	11,608,000	8,265,000	6,555,000	13,626,000
Queensland	634,000	1,232,000	1,746,000	6,000	2,514,000
New South Wales	14,033,000	16,683,000	15,275,000	1,635,000	28,196,000
Victoria	15,718,000	18,410,000	12,510,000	2,650,000	29,425,000
Tasmania	1,136,000	1,145,000	994,000	905,000	791,000
New Zealand	8,852,000	6,733,000	4,174,000	7,693,000	8,140,000
Total Australasia	50,111,000	56,610,000	43,927,000	20,461,000	84,627,000

RECAPITULATION BY CONTINENTS.

North America	588,360,000	850,693,000	777,194,000	733,786,000	640,827,000
South America	120,546,000	87,417,000	75,984,000	118,876,000	140,598,000
Europe	1,507,596,000	1,513,553,000	1,817,602,000	1,828,419,000	1,726,177,000
Asia	331,266,000	395,574,000	381,879,000	478,515,000	519,505,000
Africa	42,872,000	41,428,000	51,931,000	50,523,000	50,606,000
Australasia	50,111,000	56,610,000	43,927,000	20,461,000	84,627,000
Total	2,640,751,000	2,945,275,000	3,148,517,000	3,230,580,000	3,162,340,000

World's visible supply of wheat, first of each month, for ten years.[a]

Month.	1895–1896.	1896–1897.	1897–1898.	1898–1899.	1899–1900.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	160,303,000	137,454,000	88,378,000	86,773,000	140,299,000
August	158,042,000	124,292,000	77,590,000	70,101,000	134,525,000
September	152,276,000	126,485,000	87,075,000	66,511,000	142,595,000
October	176,584,000	151,271,000	119,162,000	83,090,000	162,877,000
November	209,859,000	190,559,000	139,321,000	106,886,000	191,189,000
December	218,796,000	202,329,000	156,016,000	135,846,000	203,477,000
January	224,778,000	184,616,000	157,008,000	147,197,000	200,388,000
February	202,832,000	173,496,000	151,717,000	146,458,000	190,535,000
March	191,905,000	155,533,000	140,571,000	151,124,000	181,527,000
April	180,627,000	139,049,000	132,037,000	144,950,000	184,141,000
May	161,149,000	121,491,000	111,233,000	139,521,000	175,776,000
June	147,564,000	106,912,000	109,845,000	136,952,000	159,405,000

[a] From Broomhall's Corn Trade News.

World's visible supply of wheat, first of each month, for ten years—Continued.

Month.	1900–1901.	1901–1902.	1902–1903.	1903–1904.	1904–1905.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	149,839,000	135,692,000	103,671,000	95,820,000	118,073,000
August	150,193,000	132,379,000	93,914,000	87,566,000	103,740,000
September	164,629,000	141,071,000	102,364,000	96,907,000	115,188,000
October	188,200,000	159,465,000	133,376,000	132,972,000	144,400,000
November	200,892,000	169,854,000	163,491,000	145,618,000	170,240,000
December	203,237,000	202,108,000	179,483,000	161,891,000	186,891,000
January	200,534,000	200,990,000	174,640,000	167,712,000	178,710,000
February	197,851,000	202,278,000	168,170,000	159,464,000	171,124,000
March	192,749,000	191,877,000	163,658,000	152,035,000	165,370,000
April	187,817,000	179,789,000	149,748,000	147,859,000	....
May	171,753,000	155,486,000	127,088,000	145,840,000	....
June	152,518,000	131,255,000	112,963,000	133,190,000	....

World's exports of wheat and flour for five years, 1900–1904. [a]

[Crop years ending August 1.]

Country.	1900.	1901.	1902.	1903.	1904.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States and Canada	188,256,000	249,192,000	261,248,000	237,472,000	142,104,000
Russia	58,960,000	77,152,000	87,448,000	134,176,000	138,160,000
Balkan Peninsula	16,336,000	40,368,000	44,152,000	57,008,000	56,952,000
Argentina and Uruguay	79,408,000	40,216,000	21,144,000	[b] 61,440,000	[b] 81,080,000
India	3,824,000	5,056,000	15,600,000	27,192,000	56,968,000
Australasia	7,040,000	18,496,000	14,792,000	....	28,280,000
Austria-Hungary	2,072,000	4,424,000	1,352,000	2,992,000	4,936,000
Chile, North Africa, Persia, Turkey-in-Asia, Cyprus, etc	15,944,000	20,016,000	17,640,000	9,856,000	10,568,000
Total	371,840,000	454,920,000	463,376,000	530,136,000	519,048,000

[a] From Broomhall's Corn Trade News.
[b] Non-European quantities are included in the figures for the years 1903 and 1904.

Visible supply of wheat in the United States and Canada, first of each month, for ten years.

EAST OF ROCKY MOUNTAINS.[a]

Month.	1895–1896.	1896–1897.	1897–1898.	1898–1899.	1899–1900.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	53,568,000	61,354,000	27,090,000	18,069,000	46,544,000
August	46,767,000	58,414,000	23,793,000	11,430,000	49,155,000
September	44,732,000	57,588,000	20,362,000	10,499,000	48,087,000
October	55,078,000	63,955,000	31,508,000	22,857,000	60,040,000
November	75,598,000	76,716,000	42,609,000	33,930,000	77,195,000
December	87,688,000	76,433,000	49,859,000	45,914,000	84,687,000
January	97,769,000	73,270,000	54,173,000	51,057,000	89,252,000
February	97,592,000	68,092,000	51,105,000	51,648,000	87,473,000
March	94,538,000	61,664,000	45,021,000	51,085,000	83,935,000
April	89,156,000	55,946,000	40,577,000	51,747,000	77,113,000
May	80,390,000	49,684,000	31,039,000	47,258,000	70,764,000
June	68,773,000	37,975,000	27,479,000	42,092,000	57,617,000

Month.	1900–1901.	1901–1902.	1902–1903.	1903–1904.	1904–1905.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	59,063,000	37,819,000	26,786,000	24,142,000	21,131,000
August	60,398,000	40,924,000	31,436,000	21,480,000	19,508,000
September	69,003,000	42,242,000	33,579,000	22,824,000	20,905,000
October	76,071,000	53,790,000	44,217,000	33,043,000	29,230,000
November	82,238,000	64,616,000	67,490,000	49,269,000	48,752,000
December	89,591,000	85,631,000	78,352,000	59,050,000	60,387,000
January	88,456,000	94,900,000	80,769,000	61,827,000	61,240,000
February	86,324,000	88,800,000	81,348,000	62,118,000	57,697,000
March	79,300,000	82,790,000	76,336,000	55,459,000	52,907,000
April	73,879,000	73,576,000	67,954,000	49,639,000	46,865,000
May	60,298,000	54,610,000	52,585,000	45,307,000	....
June	47,109,000	37,676,000	36,040,000	29,685,000	....

[a] The figures for stocks east of the Rocky Mountains represent 62 principal points of accumulation, including the Manitoba elevators and stocks afloat on lakes and canals, as reported by Bradstreet's.

Visible supply of wheat in the United States and Canada, first of each month, for ten years—Continued.

PACIFIC COAST.

Month.	1895–1896.	1896–1897.	1897–1898.	1898–1899.	1899–1900.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	6,549,000	1,927,000	1,112,000	2,935,000	3,409,000
August	6,850,000	1,917,000	2,247,000	2,608,000	4,188,000
September	8,799,000	3,512,000	4,651,000	3,065,000	6,282,000
October	9,760,000	5,454,000	6,251,000	4,671,000	8,858,000
November	9,651,000	6,883,000	7,391,000	5,621,000	11,085,000
December	8,276,000	6,548,000	6,944,000	6,269,000	10,678,000
January	7,116,000	4,189,000	6,661,000	5,923,000	9,022,000
February	5,559,000	3,005,000	5,318,000	5,030,000	8,923,000
March	4,296,000	1,857,000	4,424,000	5,104,000	7,814,000
April	3,822,000	1,730,000	3,466,000	4,321,000	7,207,000
May	3,182,000	1,614,000	3,051,000	4,455,000	7,050,000
June	2,556,000	1,221,000	3,236,000	3,635,000	6,866,000

Month.	1900–1901.	1901–1902.	1902–1903.	1903–1904.	1904–1905.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	5,903,000	3,228,000	2,725,000	1,775,000	1,668,000
August	5,770,000	3,935,000	2,345,000	1,400,000	1,351,000
September	7,483,000	4,266,000	3,024,000	1,798,000	1,582,000
October	10,208,000	6,235,000	4,737,000	3,227,000	4,106,000
November	9,983,000	7,262,000	4,719,000	3,447,000	3,874,000
December	10,057,000	7,378,000	5,361,000	3,591,000	3,733,000
January	8,686,000	7,186,000	4,992,000	3,282,000	3,458,000
February	8,717,000	6,521,000	4,373,000	2,689,000	3,051,000
March	6,972,000	5,542,000	3,435,000	2,930,000	2,726,000
April	6,325,000	5,428,000	3,810,000	2,472,000	2,486,000
May	5,084,000	3,685,000	3,683,000	2,078,000	....
June	4,672,000	3,139,000	2,546,000	2,078,000	....

Statement showing the amount of wheat in farmers' hands, visible supply of the United States and Canada, and of the world, and price, on March 1, 1891–1905.

Year.	Stocks in farmers' hands in United States.	Visible supply of the United States and Canada.	Visible supply of the world.	Price at Chicago.
	Bushels.	*Bushels.*	*Bushels.*	*Cts. per bu.*
1891	112,470,655	50,995,000	....	94¼
1892	171,070,881	68,007,000	181,400,000	87⅜
1893	135,205,430	110,693,000	229,300,000	72⅝
1894	114,059,560	105,863,000	222,400,000	58⅜
1895	74,999,790	110,546,000	212,400,000	52¼
1896	123,045,290	98,834,000	191,900,000	66½
1897	88,149,072	63,521,000	155,500,000	74½
1898	121,320,500	49,445,000	140,600,000	104½
1899	198,056,496	56,189,000	151,100,000	72⅞
1900	158,745,595	91,749,000	181,500,000	64⅛
1901	128,098,074	86,272,000	192,700,000	74
1902	173,702,583	88,332,000	191,900,000	76
1903	164,047,106	79,771,000	163,700,000	74⅛
1904	132,608,382	58,389,000	152,000,000	92
1905	111,054,959	55,633,000	165,400,000	116

Condition of the wheat crop of the United States, monthly, 1886–1904.

Year.	Winter wheat.					Spring wheat.			
	April.	May.	June.	July.	When harvested.	June.	July.	August.	When harvested.
1886	94.1	94.9	92.7	91.2	90.8	98.5	83.3	80.1	82.5
1887	88.1	85.8	84.9	83.5	84.0	87.3	79.3	78.8	78.1
1888	82.0	73.1	73.3	75.6	77.4	92.8	95.9	87.3	77.2
1889	94.0	96.0	93.1	92.0	89.4	94.4	83.3	81.2	83.8
1890	81.0	80.0	78.1	76.2	73.5	91.3	94.4	83.2	79.8
1891	96.9	97.9	96.6	96.2	96.7	92.6	94.1	95.5	97.2
1892	81.2	84.0	88.3	89.6	87.6	92.3	90.9	87.3	81.2
1893	77.4	75.3	75.5	77.7	*a*74.0	86.4	74.1	67.0	....
1894	86.7	81.4	83.2	83.9	*a*83.7	88.0	68.4	67.1	....
1895	81.4	82.9	71.1	65.8	*a*75.4	97.8	102.2	95.9	....
1896	77.1	82.7	77.9	75.6	*a*74.6	99.9	93.3	78.9	....
1897	81.4	80.2	78.5	81.2	*a*85.7	89.6	91.2	86.7	....
1898	86.7	86.5	90.8	85.7	*a*86.7	100.9	95.0	96.5	....
1899	77.9	76.2	67.3	65.6	*a*70.9	91.4	91.7	83.6	....
1900	82.1	88.9	82.7	80.8	*a*69.6	87.3	55.2	56.4	....
1901	91.7	94.1	87.8	88.3	*a*82.8	92.0	95.6	80.3	....
1902	78.7	76.4	76.1	77.0	*a*80.0	95.4	92.4	89.7	....
1903	97.3	92.6	82.2	78.8	*a*74.7	95.9	82.5	77.1	....
1904	76.5	76.5	77.7	78.7	....	93.4	93.7	87.5	66.2

a Includes both winter and spring.

Acreage, production, value, prices, and exports of wheat of the United States, 1866–1904.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1.	Farm value, Dec. 1.	Chicago cash price per bushel.				Domestic exports, including flour, fiscal years beginning July 1.
						December.		May of following year.		
						Low.	High.	Low.	High.	
	Acres.	*Bush.*	*Bushels.*	*Cents.*	*Dollars.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Bushels.*
1866	15,424,496	9.9	151,999,906	152.7	232,109,630	129	145	185	211	12,646,941
1867	18,321,561	11.6	212,441,400	145.2	308,387,146	126	140	134	161	25,284,803
1868	18,460,132	12.1	224,036,600	108.5	243,032,746	80	88	87	96	29,717,201
1869	19,181,004	13.6	260,146,900	76.5	199,024,996	63	76	79	92	53,900,780
1870	18,992,591	12.4	235,884,700	94.4	222,766,969	91	98	113	120	52,580,111
1871	19,943,893	11.6	230,722,400	114.5	264,075,851	107	111	120	143	38,995,755
1872	20,858,359	11.9	249,997,100	111.4	278,522,068	97	108	112	122	52,014,715
1873	22,171,676	12.7	281,254,700	106.9	300,669,533	96	106	105	114	91,510,398
1874	24,967,027	12.3	308,102,700	86.3	265,881,167	78	83	78	94	72,912,817
1875	26,381,512	11.1	292,136,000	89.5	261,396,926	82	91	89	100	74,750,682
1876	27,627,021	10.5	289,356,500	96.3	278,697,238	104	117	130	172	57,043,936
1877	26,277,546	13.9	364,194,146	105.7	385,089,444	103	108	98	113	92,071,726
1878	32,108,560	13.1	420,122,400	77.6	325,814,119	81	84	91	102	150,502,506
1879	32,545,950	13.8	448,756,630	110.8	497,030,142	122	133½	112½	119	180,304,180
1880	37,986,717	13.1	498,549,868	95.1	474,201,850	93½	109¾	101	112⅝	186,321,514
1881	37,709,020	10.2	383,280,090	119.2	456,880,427	124¾	129	123	140	121,892,389
1882	37,067,194	13.6	504,185,470	88.4	445,602,125	91⅛	94¾	108	113⅜	147,811,316
1883	36,455,593	11.6	421,086,160	91.1	383,649,272	94⅝	99¼	85	94¾	111,534,182
1884	39,475,885	13.0	512,765,000	64.5	330,862,260	69½	76⅞	85⅜	90¾	132,570,366
1885	34,189,246	10.4	357,112,000	77.1	275,320,390	82⅞	89	72⅛	79	94,565,793
1886	36,806,184	12.4	457,218,000	68.7	314,226,020	75⅛	79½	80¾	88¾	153,804,969
1887	37,641,783	12.1	456,329,000	68.1	310,612,960	75⅛	79¼	81¼	89⅞	119,625,344
1888	37,336,138	11.1	415,868,000	92.6	385,248,030	96⅝	105½	77¼	95½	88,600,742
1889	38,123,859	12.9	490,560,000	69.8	342,491,707	76¾	80½	89¾	100	109,430,467
1890	36,087,154	11.1	399,262,000	83.8	334,773,678	87½	92¾	98⅞	108	106,181,316
1891	39,916,897	15.3	611,780,000	83.9	513,472,711	89⅜	93¼	80	85¾	225,665,812
1892	38,554,430	13.4	515,949,000	62.4	322,111,881	69½	73	68¼	76¼	191,912,635
1893	34,629,418	11.4	396,131,725	53.8	213,171,381	59⅛	64½	52⅛	60⅛	164,283,129
1894	34,882,436	13.2	460,267,416	49.1	225,902,025	52¾	63⅝	60¾	85⅜	144,812,718
1895	34,047,332	13.7	467,102,947	50.9	237,938,998	53¾	64¾	57⅛	67⅝	126,443,968
1896	34,618,646	12.4	427,684,346	72.6	310,602,539	74⅝	93⅛	68¾	97⅞	145,124,972
1897	39,465,066	13.4	530,149,168	80.8	428,547,121	92	109	117	185	217,306,005
1898	44,055,278	15.3	675,148,705	58.2	392,770,320	62¾	70	68⅜	79½	222,618,420
1899	44,592,516	12.3	547,303,846	58.4	319,545,259	64	69½	63⅝	67½	186,096,762
1900	42,495,385	12.3	522,229,505	61.9	323,515,177	69¼	74⅝	70	75⅛	215,990,073
1901	49,895,514	15.0	748,460,218	62.4	467,350,156	73	79½	72⅜	76¼	234,772,516
1902	46,202,424	14.5	670,063,008	63.0	422,224,117	71⅞	77¾	74¾	80⅝	202,905,598
1903	49,464,967	12.9	637,821,835	69.5	443,024,826	77¾	87	87¾	101½	120,727,613
1904	44,074,875	12.5	552,399,517	92.4	510,489,874	115	122	......	......	....

The preceding table shows that the greatest area in wheat, 49,895,514 acres, was reported in 1901; the greatest production, 748,460,218 bushels, in 1901; the greatest farm value on December 1, $513,472,711, in 1891; the greatest average yield per acre, 15.3 bushels, in 1891 and in 1898; the greatest average farm price per bushel on December 1, $1.527, in 1866. For the five years 1900-1904 the average area was 46,426,633 acres; the average production, 626,194,817 bushels; the average farm value on December 1, $433,320,830; the average yield per acre, 13.5 bushels; the average farm price per bushel on December 1, 69.2 cents.

Acreage, production, value, and distribution of wheat of the United States in 1904 by States.

States and Territories.	Crop of 1904. Acreage.	Crop of 1904. Production.	Crop of 1904. Value.	Stock in farmers' hands March 1, 1905.		Shipped out of county where grown.
	Acres.	*Bushels.*	*Dollars.*	*Bushels.*	*Per cent.*	*Bushels.*
Maine	7,725	179,992	187,192	53,998	30	....
Vermont	1,606	40,311	45,551	14,109	35	403
New York	474,572	5,362,664	5,845,304	1,233,413	23	911,653
New Jersey	104,673	1,392,151	1,531,366	348,038	25	292,352
Pennsylvania	1,550,210	21,857,961	23,606,598	7,431,707	34	4,808,751
Delaware	112,537	1,676,801	1,810,945	452,736	27	888,705
Maryland	770,710	10,327,514	10,947,165	2,168,778	21	6,609,609
Virginia	711,477	7,257,065	7,910,201	1,669,125	23	1,814,266
North Carolina	571,228	4,912,561	5,845,948	1,375,517	28	294,754
South Carolina	279,926	2,267,401	2,856,925	430,806	19	90,696
Georgia	291,370	2,564,056	3,230,711	743,576	29	128,203
Alabama	102,926	1,060,138	1,219,159	233,230	22	53,007
Mississippi	2,909	25,599	25,855	4,096	16	256
Texas	1,166,688	12,483,562	13,731,918	1,872,534	15	3,120,890
Arkansas	217,674	2,198,507	2,220,492	549,627	25	131,910
Tennessee	808,558	9,298,417	10,321,243	1,952,668	21	2,882,509
West Virginia	312,755	3,158,826	3,443,120	789,706	25	347,471
Kentucky	644,678	7,349,329	8,010,769	1,469,866	20	2,131,305
Ohio	1,527,259	17,563,478	19,319,826	4,215,235	24	6,498,487
Michigan	701,327	6,873,005	7,422,845	1,305,871	19	1,855,711
Indiana	1,361,521	12,525,993	13,277,553	2,254,679	18	4,008,318
Illinois	1,561,045	21,542,421	21,757,845	3,662,212	17	8,832,393
Wisconsin	483,006	7,483,563	7,333,892	1,870,891	25	1,047,699
Minnesota	5,339,395	68,344,256	59,459,503	16,402,621	24	47,840,979
Iowa	967,654	11,266,220	10,139,598	3,041,879	27	2,929,217
Missouri	2,321,636	27,163,141	26,076,615	4,889,365	18	12,495,045
Kansas	5,231,153	65,019,471	57,867,329	10,403,115	16	44,213,240
Nebraska	2,313,088	31,453,943	27,364,930	7,548,946	24	18,872,366
South Dakota	3,287,165	31,556,784	24,929,859	8,204,764	26	22,405,317
North Dakota	4,567,135	53,892,193	43,652,676	10,239,517	19	44,191,598
Montana	108,608	2,596,731	2,311,091	649,183	25	701,117
Wyoming	23,574	520,985	468,886	161,505	31	15,630
Colorado	259,546	5,917,649	5,385,061	1,183,530	20	2,485,413
New Mexico	34,428	440,678	467,119	88,729	19	13,220
Arizona	13,964	356,082	402,373	49,851	14	....
Utah	180,219	4,793,825	4,122,690	1,342,271	28	1,965,468
Nevada	25,283	662,415	609,422	218,597	33	6,624
Idaho	298,056	6,832,727	5,466,181	956,582	14	4,304,618
Washington	1,446,733	32,140,693	25,712,482	3,535,466	11	25,069,670
Oregon	740,250	14,050,193	11,380,657	1,967,027	14	8,992,124
California	1,618,043	17,474,864	15,377,880	1,922,235	11	10,310,170
Oklahoma	1,285,527	15,040,666	13,987,819	1,804,880	12	8,723,586
Indian Territory	246,438	3,474,776	3,405,280	347,478	10	486,469
United States	44,074,875	552,399,517	510,489,874	111,054,959	20.1	302,771,219

Acreage, production, and farm value on December 1, of winter and spring wheat in the United States in 1904.

States and Territories.	Winter wheat.					Spring wheat.				
	Acreage.	Average yield per acre.	Production.	Average farm price Dec. 1.	Farm value Dec. 1.	Acreage.	Average yield per acre.	Production.	Average farm price Dec. 1.	Farm value Dec. 1.
	Acres.	*Bu.*	*Bushels.*	*Cents.*	*Dollars.*	*Acres.*	*Bu.*	*Bushels.*	*Cts.*	*Dollars.*
Maine						7,725	23.3	179,992	104	187,192
Vermont						1,606	25.1	40,311	113	45,551
New York	474,572	11.3	5,362,664	109	5,845,301					
New Jersey	104,673	13.3	1,392,151	110	1,531,366					
Pennsylvania	1,550,210	14.1	21,857,961	108	23,606,598					
Delaware	112,537	14.9	1,676,801	108	1,810,945					
Maryland	770,710	13.4	10,327,514	106	10,947,165					
Virginia	711,477	10.2	7,257,065	109	7,910,201					
North Carolina	571,228	8.6	4,912,561	119	5,845,948					
South Carolina	279,926	8.1	2,267,401	126	2,856,925					
Georgia	291,370	8.8	2,564,056	126	3,230,711					
Alabama	102,926	10.3	1,060,138	115	1,219,159					
Mississippi	2,909	8.8	25,599	101	25,855					
Texas	1,166,688	10.7	12,483,562	110	13,731,918					
Arkansas	217,674	10.1	2,198,507	101	2,220,492					
Tennessee	808,558	11.5	9,298,417	111	10,321,243					
West Virginia	312,755	10.1	3,158,826	109	3,443,120					
Kentucky	644,678	11.4	7,349,329	109	8,010,769					
Ohio	1,527,259	11.5	17,563,478	110	19,319,826					
Michigan	701,327	9.8	6,873,005	108	7,422,845					
Indiana	1,361,521	9.2	12,525,993	106	13,277,553					
Illinois	1,561,045	13.8	21,542,421	101	21,757,845					
Wisconsin	115,543	17.7	2,045,111	98	2,004,209	367,463	14.8	5,438,452	98	5,329,683
Minnesota						5,339,395	12.8	68,344,256	87	59,459,503
Iowa	55,944	15.6	872,726	90	785,453	911,710	11.4	10,393,494	90	9,354,145
Missouri	2,321,636	11.7	27,163,141	96	26,076,615					
Kansas	4,989,621	12.3	61,372,338	89	54,621,381	241,532	15.1	3,647,133	89	3,245,948
Nebraska	1,880,394	14.4	27,077,674	87	23,557,576	433,294	10.1	4,376,269	87	3,807,354
South Dakota						3,287,165	9.6	31,556,784	79	24,929,859
North Dakota						4,567,135	11.8	53,892,193	81	43,652,676
Montana						108,608	23.9	2,596,731	89	2,311,091
Wyoming						23,574	22.1	520,985	90	468,886
Colorado						259,546	22.8	5,917,649	91	5,385,061
New Mexico						34,428	12.8	440,678	106	467,119
Arizona						13,964	25.5	356,082	113	402,373
Utah						180,219	26.6	4,793,825	86	4,122,690
Nevada						25,283	26.2	662,415	92	609,422
Idaho	154,919	22.3	3,454,694	80	2,763,755	143,137	23.6	3,378,033	80	2,702,426
Washington	521,451	28.1	14,652,773	80	11,722,218	925,282	18.9	17,487,830	80	13,990,264
Oregon	402,296	21.4	8,609,134	81	6,973,399	337,954	16.1	5,441,059	81	4,407,258
California	1,618,043	10.8	17,474,864	88	15,377,880					
Oklahoma	1,285,527	11.7	15,040,666	93	13,987,819					
Indian Ter.	246,438	14.1	3,474,776	98	3,405,280					
United States	26,865,855	12.4	332,935,346	97.8	325,611,373	17,209,020	12.8	219,464,171	84.2	184,878,501

Average yield per acre of wheat in the United States, 1895–1904, by States.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	19.2	22.0	16.5	19.5	22.5	19.5	23.9	25.3	25.5	23.3
New Hampshire	19.3	21.0	16.0	19.0	17.2	16.3				
Vermont	29.0	24.5	17.0	22.5	22.0	23.5	18.7	18.8	20.9	25.1
Connecticut			20.0	20.0	18.3	20.8				
New York	18.1	16.0	21.4	21.2	18.5	17.7	13.1	16.8	17.8	11.3
New Jersey	12.4	15.3	18.5	17.4	14.5	19.1	16.8	16.0	14.0	13.3
Pennsylvania	16.6	14.0	19.7	17.5	13.6	13.5	17.1	15.8	15.6	14.1
Delaware	11.6	18.0	21.5	13.3	12.8	20.3	18.5	16.5	10.2	14.9
Maryland	17.0	17.0	19.2	15.3	14.1	19.5	17.2	14.7	12.5	13.4
Virginia	9.3	9.3	12.0	14.1	8.4	11.9	10.9	5.7	8.7	10.2
North Carolina	6.9	7.3	8.0	9.2	6.7	9.6	8.7	5.3	5.1	8.6
South Carolina	6.4	6.8	8.7	10.6	6.5	9.0	8.8	5.6	6.5	8.1
Georgia	6.2	8.0	9.4	10.0	6.8	9.1	8.2	6.0	6.2	8.8
Alabama	7.5	8.0	10.0	12.0	7.6	9.5	8.7	6.0	9.1	10.3
Mississippi	8.0	8.5	10.0	13.9	7.7	9.6	8.8	8.0	8.0	8.8
Texas	5.7	11.7	15.8	14.8	11.1	18.4	8.9	9.0	13.4	10.7
Arkansas	9.4	8.0	10.5	11.0	8.6	10.1	8.8	9.1	7.0	10.1

Average yield per acre of wheat in the United States, 1895–1904, by States—Continued.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Tennessee	8.8	8.5	11.2	13.2	8.7	9.9	10.8	7.2	7.1	11.5
West Virginia	10.6	10.3	13.4	13.8	9.3	9.8	10.9	7.7	10.2	10.1
Kentucky	10.9	8.7	13.6	15.4	9.1	13.0	12.1	9.3	8.4	11.4
Ohio	13.3	9.0	16.9	16.9	14.2	6.0	15.3	17.1	13.7	11.5
Michigan	13.2	12.8	15.6	20.8	8.4	7.6	11.1	17.7	15.5	9.8
Indiana	9.2	9.0	13.0	15.6	9.8	5.3	15.8	16.0	10.0	9.2
Illinois	11.0	14.7	7.9	11.0	10.0	13.0	17.6	17.9	8.4	13.8
Wisconsin	15.5	13.3	12.5	18.0	15.5	15.5	16.1	18.1	15.6	15.5
Minnesota	23.0	14.2	13.0	15.8	13.4	10.5	12.9	13.9	13.1	12.8
Iowa	19.5	16.0	13.0	16.7	13.0	15.6	16.2	12.7	12.4	11.6
Missouri	12.0	11.7	9.0	9.8	9.9	12.5	15.9	19.9	8.7	17.7
Kansas	7.7	10.6	15.5	14.2	9.8	17.7	18.5	10.4	14.1	12.4
Nebraska	12.0	14.0	14.5	16.4	10.3	12.0	17.1	20.9	15.7	13.6
South Dakota	12.0	11.2	8.0	12.4	10.7	6.9	12.9	12.2	13.8	9.6
North Dakota	21.0	11.8	10.3	14.4	12.8	4.9	13.1	15.9	12.7	11.8
Montana	23.9	25.5	32.5	29.5	25.7	26.6	26.5	26.0	28.2	23.9
Wyoming	26.0	24.5	25.0	23.7	18.8	17.6	24.5	23.5	20.9	22.1
Colorado	23.5	17.5	24.0	26.3	23.7	22.6	24.1	18.0	26.6	22.8
New Mexico	20.4	21.0	24.0	23.8	13.8	21.0	21.5	17.1	18.4	12.8
Arizona	20.5	23.0	18.0	31.7	15.3	14.6	21.8	18.7	25.3	25.5
Utah	22.4	26.5	21.0	28.0	20.7	20.9	20.5	21.2	22.6	26.6
Nevada	21.7	30.0	24.3	29.0	18.0	24.5	25.1	27.1	27.6	26.2
Idaho	17.8	24.5	22.0	31.0	24.2	20.8	21.2	22.1	21.1	22.9
Washington	15.5	18.0	23.5	24.2	22.7	23.5	29.1	22.2	20.3	22.2
Oregon	20.0	17.0	17.0	20.5	19.2	13.8	21.1	20.0	18.2	19.0
California	13.0	14.6	10.0	9.1	14.1	10.3	13.0	10.9	11.2	10.8
Oklahoma	11.4	13.0	19.0	14.9	13.3	19.0	16.4	11.1	14.9	11.7
Indian Territory	......	......	......	......	......	......	12.2	12.3	12.0	14.1
General average	13.7	12.4	13.4	15.3	12.3	12.3	15.0	14.5	12.9	12.5

Average yield of wheat in certain countries, in bushels per acre; 1894–1903.

Year.	United States.	Russia.	Germany.	Austria.	Hungary.	France.	United Kingdom.
	(a)	(b)	(b)	(b)	(b)	(a)	(a)
1894	13.2	10.8	25.1	17.4	18.2	20.1	31.7
1895	13.7	9.8	24.4	15.3	20.7	19.7	27.2
1896	12.4	9.0	26.4	15.9	19.4	20.0	34.7
1897	13.4	7.3	25.3	13.2	11.7	15.1	30.0
1898	15.3	9.8	27.2	18.0	17.1	21.1	35.8
1899	12.3	9.1	28.4	18.9	17.8	21.2	33.8
1900	12.3	8.1	27.9	15.5	16.9	19.2	29.5
1901	15.0	7.9	23.5	16.7	15.1	18.5	31.9
1902	14.5	11.1	30.3	19.0	20.7	20.2	33.9
1903	12.9	10.6	29.3	17.7	18.9	22.7	31.1
Average	13.5	9.4	26.8	16.8	17.6	19.8	32.0

[a] Winchester bushels. [b] Bushels of 60 pounds.

Average value per acre of wheat in the United States, based upon farm value December 1, 1895–1904, by States.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Maine	$15.74	$18.48	$17.49	$17.36	$20.47	$17.55	$23.18	$23.28	$24.99	$24.23
New Hampshire	14.67	21.00	17.60	17.48	16.34	15.00	......	......	......	......
Vermont	20.01	22.79	17.68	20.25	18.70	18.33	17.58	20.49	19.85	28.36
Connecticut	......	......	20.00	17.60	17.39	17.05	......	......	......	......
New York	12.31	14.08	19.26	15.26	14.80	13.63	10.74	13.27	14.42	12.32
New Jersey	8.80	13.62	17.20	12.70	10.88	14.13	12.10	12.16	11.48	14.63
Pennsylvania	10.79	11.62	17.93	11.90	8.98	9.72	12.31	11.53	12.32	15.23
Delaware	7.42	15.66	20.21	9.18	8.70	14.21	13.13	12.38	7.96	16.09
Maryland	10.88	14.96	17.86	10.71	9.59	13.84	12.21	10.58	9.88	14.20
Virginia	6.05	7.44	11.04	9.31	5.80	8.57	7.96	4.50	7.31	11.12
North Carolina	4.97	6.06	7.52	7.18	5.49	7.87	7.13	4.88	4.95	10.23
South Carolina	5.63	6.05	10.27	9.96	6.44	9.09	8.62	5.71	6.56	10.21
Georgia	5.08	7.12	9.68	9.80	6.66	8.64	7.71	5.88	5.95	11.09

Average value per acre of wheat in the United States, based upon farm value December 1, 1895–1904, by States—Continued.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Alabama	$6.00	$6.80	$10.10	$10.80	$6.76	$8.45	$7.66	$5.58	$8.65	$11.85
Mississippi	4.88	6.97	9.90	11.54	6.01	8.66	7.57	6.80	7.44	8.89
Texas	3.76	8.78	14.06	10.06	7.55	11.78	6.94	6.98	10.45	11.77
Arkansas	5.55	5.68	8.82	6.38	5.50	6.57	6.86	6.10	5.46	10.20
Tennessee	5.46	6.29	10.64	8.84	6.79	7.82	7.99	5.47	5.96	12.77
West Virginia	7.31	8.03	11.93	9.80	6.60	7.55	8.39	6.31	8.67	11.01
Kentucky	6.65	6.61	12.10	9.55	6.01	8.97	8.71	6.88	6.80	12.43
Ohio	7.98	7.02	14.87	11.15	9.09	4.26	10.86	12.14	10.96	12.65
Michigan	7.92	10.75	13.57	13.31	5.46	5.24	7.88	12.21	11.94	10.58
Indiana	5.24	7.20	11.57	9.83	6.27	3.71	11.06	10.88	7.80	9.75
Illinois	5.83	10.88	7.03	6.60	6.30	8.32	12.14	10.56	6.30	13.94
Wisconsin	7.91	9.31	10.50	10.62	9.46	9.92	10.48	11.61	11.22	15.18
Minnesota	10.12	9.66	10.01	8.53	7.37	6.62	7.74	8.48	9.04	11.14
Iowa	8.97	9.92	9.75	8.68	7.15	9.20	9.75	6.96	7.69	10.48
Missouri	6.12	8.19	7.65	5.78	6.14	7.88	10.97	11.54	6.18	11.23
Kansas	3.47	6.68	11.47	7.10	5.10	9.73	10.92	5.73	8.33	11.06
Nebraska	4.80	8.12	10.00	7.71	5.05	6.36	9.23	10.23	8.47	11.83
South Dakota	4.56	6.94	5.52	6.20	5.35	4.00	6.84	6.95	8.56	7.58
North Dakota	7.98	7.55	7.62	7.34	6.53	2.84	7.07	9.22	8.00	9.56
Montana	17.45	17.49	22.10	17.11	15.68	16.23	17.76	16.12	18.61	21.28
Wyoming	16.64	15.19	17.50	16.35	12.60	13.38	16.91	19.04	15.47	19.89
Colorado	13.16	10.67	16.80	14.73	13.51	13.33	16.15	13.50	17.56	22.75
New Mexico	14.89	13.86	18.00	14.76	8.42	14.28	15.48	14.71	13.80	13.57
Arizona	13.33	18.40	13.32	29.16	9.79	11.53	18.53	19.64	23.53	28.82
Utah	9.86	18.02	14.28	15.12	10.97	11.49	14.35	16.11	18.08	22.88
Nevada	10.63	20.70	21.87	27.55	13.68	17.15	22.09	25.56	27.32	24.10
Idaho	8.37	15.93	15.40	15.81	12.10	9.57	12.93	15.44	15.86	18.34
Washington	6.35	13.32	15.98	13.07	11.58	11.99	13.67	14.44	14.04	17.77
Oregon	9.40	12.24	12.24	12.71	10.18	7.59	11.37	13.37	13.98	15.37
California	7.80	12.12	8.30	6.55	8.74	5.97	7.80	8.72	9.74	9.50
Oklahoma	5.47	8.84	14.44	7.75	7.05	10.07	10.33	6.44	9.39	10.88
Indian Territory	......	......	......	......	......	......	8.42	7.50	8.28	13.82
General average	6.99	8.97	10.86	8.92	7.17	7.61	9.37	9.14	8.96	11.58

Average farm price of wheat per bushel in the United States December 1, 1895–1904, by States.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Maine	$0.82	$0.84	$1.06	$0.89	$0.91	$0.90	$0.97	$0.92	$0.98	$1.04
New Hampshire	.76	1.00	1.10	.92	.95	.92	......	......	......	......
Vermont	.69	.93	1.04	.90	.85	.78	.94	1.09	.95	1.13
Connecticut	.68	......	1.00	.88	.95	.82	......	......	......	......
New York	.68	.88	.90	.72	.80	.77	.82	.79	.81	1.09
New Jersey	.71	.89	.93	.73	.75	.74	.72	.76	.82	1.10
Pennsylvania	.65	.83	.91	.68	.66	.72	.72	.73	.79	1.08
Delaware	.64	.87	.94	.69	.68	.70	.71	.75	.78	1.08
Maryland	.64	.88	.93	.70	.68	.71	.71	.72	.79	1.06
Virginia	.65	.80	.92	.66	.69	.72	.73	.79	.84	1.09
North Carolina	.72	.83	.94	.78	.82	.82	.82	.92	.97	1.19
South Carolina	.88	.89	1.18	.94	.99	1.01	.98	1.02	1.01	1.26
Georgia	.82	.89	1.03	.98	.98	.95	.94	.98	.96	1.26
Alabama	.80	.85	1.01	.90	.89	.89	.88	.93	.95	1.15
Mississippi	.61	.82	.99	.83	.78	.84	.86	.85	.93	1.01
Texas	.66	.75	.89	.68	.68	.64	.78	.77	.78	1.10
Arkansas	.59	.71	.84	.58	.64	.65	.78	.67	.78	1.01
Tennessee	.62	.74	.95	.67	.78	.79	.74	.76	.84	1.11
West Virginia	.69	.78	.89	.71	.71	.77	.77	.82	.85	1.09
Kentucky	.61	.76	.89	.62	.66	.69	.72	.74	.81	1.09
Ohio	.60	.78	.88	.66	.64	.71	.71	.71	.80	1.10
Michigan	.60	.84	.87	.64	.65	.69	.71	.69	.77	1.08
Indiana	.57	.80	.89	.63	.64	.70	.70	.68	.78	1.06
Illinois	.53	.74	.89	.60	.63	.64	.69	.59	.75	1.01
Wisconsin	.51	.70	.84	.59	.61	.64	.65	.64	.72	.98
Minnesota	.44	.68	.77	.54	.55	.63	.60	.61	.69	.87
Iowa	.46	.62	.75	.52	.55	.59	.60	.55	.62	.90
Missouri	.51	.70	.85	.59	.62	.63	.69	.58	.71	.96
Kansas	.45	.63	.74	.50	.52	.55	.59	.55	.59	.89
Nebraska	.40	.58	.69	.47	.49	.53	.54	.49	.54	.87
South Dakota	.38	.62	.69	.50	.50	.58	.53	.57	.62	.79
North Dakota	.38	.64	.74	.51	.51	.58	.54	.58	.63	.81
Montana	.73	.66	.68	.58	.61	.61	.67	.62	.66	.89
Wyoming	.64	.62	.70	.69	.67	.76	.69	.81	.74	.90
Colorado	.56	.61	.70	.56	.57	.59	.67	.75	.66	.91

Average farm price of wheat per bushel in the United States December 1, 1895–1904, by States—Continued.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
New Mexico	$0.73	$0.66	$0.75	$0.62	$0.61	$0.68	$0.72	$0.86	$0.75	$1.06
Arizona	.65	.80	.74	.92	.64	.79	.85	1.05	.93	1.13
Utah	.44	.68	.68	.54	.53	.55	.70	.76	.80	.86
Nevada	.49	.69	.90	.95	.76	.70	.88	.98	.99	.92
Idaho	.47	.65	.70	.51	.50	.46	.61	.70	.75	.80
Washington	.41	.74	.68	.54	.51	.51	.47	.65	.69	.80
Oregon	.47	.72	.72	.62	.53	.55	.54	.67	.77	.81
California	.60	.83	.83	.72	.62	.58	.60	.80	.87	.88
Oklahoma	.48	.68	.76	.52	.53	.53	.63	.58	.63	.93
Indian Territory	......	......	......	......	......	......	.69	.61	.69	.98
General average	.509	.726	.808	.582	.584	.619	.624	.630	.695	.924

Freight rates, average for wheat, in cents, St. Louis to New Orleans, by river.

Year.	Bulk, per bushel.	Sacks, per 100 lbs.	Year.	Bulk, per bushel.	Sacks, per 100 lbs.	Year.	Bulk, per bushel.	Sacks, per 100 lbs.	Year.	Bulk, per bushel.	Sacks, per 100 lbs.
1877	8.11	20.04	1884	6.63	14.00	1891	6.88	16.28	1898	4.50	10.00
1878	7.19	17.36	1885	6.40	15.00	1892	6.50	16.87	1899	[a]4.50	10.00
1879	7.75	18.00	1886	6.50	16.00	1893	6.55	17.54	1900	[a]4.25	10.00
1880	8.25	19.00	1887	6.00	18.25	1894	5.89	17.14	1901	[a]4.25	10.00
1881	6.00	20.00	1888	6.50	15.00	1895	5.95	13.00	1902	[a]4.20	10.00
1882	6.42	20.00	1889	5.95	17.93	1896	5.00	14.54	1903	[a]5.00	10.00
1883	5.50	17.75	1890	6.58	15.66	1897	4.88	10.83	1904	([b])	([b])

[a] F. o. b. New Orleans. [b] No shipments.

Freight rates, average for wheat, in cents per bushel, New York to Chicago.

Year.	By lake and canal.[a]	By lake and rail.	By all rail.	Year.	By lake and canal.[a]	By lake and rail.	By all rail.
1875	....	12.09	20.89	1890	6.76	8.52	14.30
1876	9.82	10.19	15.12	1891	6.95	8.57	15.00
1877	11.09	14.75	19.56	1892	6.45	7.59	13.80
1878	9.96	11.99	17.56	1893	7.66	8.48	14.63
1879	11.87	13.13	17.74	1894	5.11	7.00	13.20
1880	13.13	15.80	19.80	1895	4.86	6.96	11.89
1881	8.67	10.49	14.40	1896	6.19	6.61	12.00
1882	7.23	10.91	14.47	1897	5.22	7.42	12.50
1883	9.01	11.63	16.20	1898	[b]4.45	4.91	12.00
1884	7.00	10.00	13.20	1899	[b]5.81	6.63	11.60
1885	6.54	9.02	13.20	1900	[b]4.49	5.10	9.96
1886	9.10	12.00	15.00	1901	[b]5.11	5.54	9.88
1887	9.50	12.00	15.75	1902	[b]5.26	5.89	10.62
1888	7.05	11.14	14.50	1903	[b]5.40	6.37	11.29
1889	6.92	8.97	15.00	1904	[b]4.73	5.50	11.12

[a] Including Buffalo charges and tolls. [b] Exclusive of Buffalo charges.

Wholesale prices of wheat per bushel in leading cities of the United States, 1899–1904.

Date.	New York. No. 2, red winter. Low.	New York. No. 2, red winter. High.	Baltimore. Southern, No. 2, red. Low.	Baltimore. Southern, No. 2, red. High.	Chicago. Low.	Chicago. High.	Detroit. No. 2, red. Low.	Detroit. No. 2, red. High.	St. Louis. No. 2, red winter. Low.	St. Louis. No. 2, red winter. High.	Minneapolis. No. 2, northern. Low.	Minneapolis. No. 2, northern. High.	San Francisco. No. 1, California (per cwt.). Low.	San Francisco. No. 1, California (per cwt.). High.
1899.														
January	$0.79¼	$0.87⅜	$0.76	$0.81½	$0.66½	$0.76	$0.70½	$0.76½	$0.71	$0.79½	$0.65½	$0.72¼	$1.12½	$1.18¾
February	.81	.87⅝	.74½	.78	.69¾	.74½	.72¼	.74½	.72½	.76	.67⅜	.69¼	1.10	1.13¾
March	.78⅝	.87½	.72	.78	.66	.74½	.69	.75	.69	.76	.64	.70¼	1.06¼	1.15
April	.79⅜	.85¼	.75½	.79½	.70	.76½	.71½	.76¾	.73⅝	.80	.68	.72	1.05	1.10
May	.80⅛	.87⅛	.73¼	.79½	.68⅜	.79½	.73¼	.80	.73¼	.81⅝	.67¼	.73	1.06¼	1.12½
June	.80	.85⅞	.75	.79	.71¼	.79¼	.75¼	.80¼	.73¾	.78½	.70½	.73⅞	1.10	1.12½
July	.75⅞	.81¾	.71	.75¾	.68⅝	.75⅜	.71¼	.78	.69⅝	.75	.65⅞	.71¾	1.05	1.10
August	.74⅝	.78¼	.71	.73¼	.69	.74½	.70	.74	.68⅛	.73¼	.66	.70¼	1.03¾	1.07½
September	.73¾	.77⅝	.70½	.74⅛	.69⅜	.75⅛	.70½	.73½	.68	.72	.64⅞	.67⅞	1.02½	1.07½
October	.75	.78¾	.71	.75½	.68⅜	.74¾	.70½	.73⅜	.69½	.73	.64¾	.69½	1.07½	1.12½
November	.72¾	.75⅝	.68½	.72	.65	.71½	.67½	.70¾	.68½	.70½	.61¾	.64	.97½	1.07½
December	.72⅛	.76	.70	.72	.64	.69½	.68	.72	.69½	.72	.60	.64	.96¼	.98¾
1900.											No. 1, northern.			
January	.72⅞	.78⅜	.70	.73	.61⅛	.67⅛	.66¾	.72	.66¼	.72	.62	.66¼	.95	1.00
February	.74¾	.79⅞	.73	.76	.63⅞	.67½	.70¾	.73¼	.69	.71¾	.63	.65⅞	.96¼	1.00
March	.74½	.81⅜	.71½	.75½	.64	.67	.70¼	.72½	.69	.72¼	.63⅛	.66	.95	.97½
April	.78	.81¼	.71½	.76	.64¾	.67¾	.71	.72¾	.70	.72¾	.64½	.66⅛	.95	.97½
May	.78	.82¾	.72	.73½	.63⅝	.67½	.71¾	.74	.70¼	.71¼	.64½	.66⅜	.90	.95
June	.80	.96⅞	.72	.90	.65⅞	.87½	.73¼	.91½	.68¾	.86½	.64⅞	.88⅞	.90	1.12½
July	.81	.90¼	.73	.81⅛	.74	.81½	.77½	.84½	.71⅞	.80⅛	.74¾	.82¼	1.03¾	1.08¾
August	.78¼	.83⅜	.71	.76	.71¾	.76¼	.74	.78¾	.68¾	.73	.72¼	.76	1.02½	1.06¼
September	.79¼	.85	.71¾	.77	.72½	.79⅜	.75¼	.80¾	.71	.77½	.73½	.81¼	1.03⅝	1.07½
October	.76⅞	.82⅞	.71¼	.77	.71⅜	.77⅜	.75	.79½	.69	.75⅛	.73⅞	.80¼	.95	1.02½
November	.77½	.81¼	.71¾	.73¾	.69⅝	.74¼	.74¼	.77½	.69½	.72¾	.72¾	.76⅝	.97½	1.00
December	.77⅜	.83⅛	.71½	.75½	.69¼	.74⅝	.74½	.81	.69¾	.71¼	.71⅞	.75¼	.96¼	.98¾
1901.														
January	.79⅛	.83⅛	.73¾	.78	.71⅜	.76⅜	.78	.82½	.72	.77	.73	.77½	.97½	1.01¼
February	.79⅞	.81¼	.76	.78¾	.72⅛	.74¾	.78½	.80¼	.73½	.75¾	.73	.74⅝	.95	.98¾
March	.80⅛	.82¼	.77¾	.81	.73¼	.76¼	.78½	.80	.74	.75¾	.73	.74⅝	.95	1.02½
April	.78⅛	.84⅞	.76½	.81½	.69½	.74⅞	.74	.78	.71	.76¼	.70½	.74½	1.00	1.05
May	.81⅞	.81⅞	.78¾	.80⅛	.70	.75⅛	.74½	.77¼	.73½	.76	.70⅞	.74¼	.97½	1.01¼
June	.75⅛	.85¼	.72	.79⅛	.65⅛	.77¼	.67¾	.77¼	.63¼	.75½	.62⅞	.74⅜	.96¼	1.00
July	.72⅞	.79⅞	.69¼	.75⅛	.63⅛	.71¾	.66½	.74	.61¼	.70¾	.60½	.69¾	.95	1.00
August	.76	.80⅛	.72	.78	.66⅝	.77	.68¼	.76½	.66¼	.73⅞	.66	.71½	.97½	.98¾
September	.75⅜	.77⅞	.78½	.75⅛	.68⅛	.71	.70½	.73½	.70⅜	.72½	.66¾	.69⅝	.96¼	.97½
October	.74⅝	.80⅝	.70½	.75	.66¾	.71½	.70	.74	.70½	.73½	.66	.68⅞	.95	.98¾
November	.80⅛	.83⅛	.74¼	.78	.70	.73¾	.73	.79½	.72¼	.80	.68½	.71½	.98⅜	1.01¼
December	.84⅞	.89⅞	.78⅛	.85¾	.73	.79½	.79	.90½	.81	.88½	.71¾	.77	1.01¼	1.06¼

Wholesale prices of wheat per bushel in leading cities of the United States, 1899-1904—Continued.

Date.	New York. No. 2, red winter. Low.	New York. No. 2, red winter. High.	Baltimore. Southern, No. 2, red. Low.	Baltimore. Southern, No. 2, red. High.	Chicago. Low.	Chicago. High.	Detroit. No. 2, red. Low.	Detroit. No. 2, red. High.	St. Louis. No. 2, red winter. Low.	St. Louis. No. 2, red winter. High.	Minneapolis. No. 2, northern. Low.	Minneapolis. No. 2, northern. High.	San Francisco. No. 1, California (per cwt.). Low.	San Francisco. No. 1, California (per cwt.). High.
1902.														
January	$0.85¾	$0.94¼	$0.81⅛	$0.87½	$0.74	$0.80½	$0.86	$0.93½	$0.86½	$0.92½	$0.73⅝	$0.79½	$01.05	$01.08¾
February	.85⅞	.93¼	.80	.85⅝	.72⅞	.76½	.84¼	.87½	.83¼	.89	.72¼	.75⅛	1.07½	1.12½
March	.82	.90⅜	.76	.85	.69¾	.76	.77½	.85¾	.76⅜	.86¾	.70½	.75⅛	1.10	1.12½
April	.82	.92⅛	.75	.85½	.70	.76¾	.77½	.87¼	.77¼	.83½	.70⅝	.77⅞	1.10	1.13¾
May	.88¼	.93¾	.81	.87⅛	.72⅜	.76¼	.80	.88	.76½	.84½	.74	.78	1.11¼	1.16¼
June	.87⅜	.93⅜	.76	.83	.71¼	.75¾	.79	.81½	.76	.80	.73⅛	.77½	1.11¼	1.13¾
July	.76⅞	.92¼	.70¾	.81¾	.71⅛	.79	.72	.82	.65⅛	.78	.76⅜	.80⅞	1.13¾	1.16¼
August	.74⅞	.78⅝	.66¼	.74¼	.68¼	.76	.68½	.73	.63	.68¼	.74¼	.79¾	1.12½	1.15
September	.73⅛	.77	.68	.72¾	.70	.95	.70¾	.74	.66	.68½	.66½	.71¼	1.12½	1.20
October	.73⅞	.79	.69	75½	.67½	.75½	.72	.76¾	.67¾	.72	.68	.73⅞	1.18¾	1.35
November	.76	.79⅞	.71¼	.77⅛	.69⅞	.77⅜	.75½	.80¾	.69	.71	.71⅞	.74½	1.32½	1.45
December	.76⅛	.80⅛	.71¼	.77	.71⅞	.77¾	.77½	.83	.69	.74½	.72¼	.74⅞	1.37½	1.43¾
1903.														
January	.78¼	.84⅝	.77½	.83	.70¾	.79¼	.77¾	.83½	.73½	.76½	.73⅛	.78⅛	1.36¼	1.50
February	.81⅝	.84	.80	.81	.73¾	.80½	.79	.81	.73½	.77½	.75⅞	.78	1.43¾	1.55
March	.78⅛	.83⅛	.77¾	.81	.70¼	.75⅞	.74¼	.79	.70	.75⅛	.74⅜	.77⅞	1.35	1.52½
April	.79	.86½	.78¼	.83	.71⅝	.79	.75¼	.77¾	.69½	.73⅝	.74⅞	.77⅝	1.35	1.38¾
May	.81¾	.89⅝	.79	.82⅛	.74¾	.80⅝	.76	.79½	.72	.76⅛	.76	.80⅛	1.32½	1.40
June	.85	.87	.78¼	.82	.74¼	.85⅝	.77¾	.82	.76	.83¼	.79½	.88⅛	1.32½	1.40
July	.80¼	.89⅜	.76½	.81	.75	.84	.76½	.80	.77½	.82	.83¼	.89¼	1.32½	1.50
August	.83¾	.89⅞	.79	.83⅛	.77¼	.90¼	.78½	.84	.79¼	.85	.83⅜	1.00	1.45	1.50
September	.81¾	.89⅛	.78¼	.83¼	.79½	.93	.79	.84¼	.84	.88	.82	.91¾	1.37½	1.47½
October	.82⅛	.91⅝	.80⅛	.86	.76¾	.88	.82¾	.87½	.85	.89	.78¼	.86	1.36¼	1.41¼
November	.83¾	.92⅜	.82½	.87	.75¾	.86¼	.84	.90	.85½	.90½	.77⅜	.82⅛	1.38¾	1.41¼
December	.89⅛	.99⅞	.85¾	.88¾	.77¾	.87	.89⅛	.94	.90	.94	.80½	.83⅞	1.33¾	1.40
1904.														
January	.92½	1.01	.88¼	.94	.81¼	.93½	.92	.95½	.89½	.97	.84¾	.91¼	1.35	1.40
February	.91	1.15	.94	1.12	.86	1.10	.94¼	1.12	.94	1.12	.90	1.05	1.35	1.43¾
March	1.01	1.11	.99	1.05¼	.88¼	.98¾	.97½	1.04½	.98	1.08½	.94½	1.01½	1.36¼	1.43¾
April	1.04	1.10½	.98½	1.05	.85¼	.96⅞	.98	1.05	.97	1.08	.90⅜	.98¾	1.27½	1.40
May	1.06	1.20	.99½	1.08	.87¾	1.01½	1.02½	1.12½	.98	1.10	.93⅛	.98⅝	1.26¼	1.30
June	1.04	1.15½	.82	1.03¼	.92	1.00	1.01	1.13	1.00	1.10¾	.93⅛	.97⅛	1.23¾	1.30
July	1.00	1.16	.82	.89	.94⅛	1.06½	.97	1.07	.91	1.12	.94⅜	1.02	1.23¾	1.37½
August	1.00	1.20¾	.88⅜	1.09¼	1.02	1.20	.98	1.16	.91	1.14¼	1.03½	1.24⅜	1.37½	1.46¼
September	1.08	1.25¼	1.03¼	1.14	1.16	1.22	1.11½	1.23	1.08½	1.21	1.12	1.24½	1.40	1.48¾
October	1.13½	1.26¼	1.13	1.18⅛	1.15	1.22	1.16	1.21	1.13½	1.21	1.11⅝	1.22	1.45	1.50
November	1.17¼	1.25¾	1.08⅛	1.15¼	1.15	1.20	1.16	1.22	1.12½	1.18	1.06⅝	1.19⅝	1.45	1.50
December	1.16	1.24¼	1.08¾	1.15	1.15	1.22	1.15	1.20	1.13	1.18½	1.06½	1.14½	1.45	1.50

Monthly average prices of wheat in Chicago. [a]

[Cents per bushel.]

Month.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
January	75 3/16	61 7/16	55 1/8	62 5/16	82 5/8	99 3/16	71 1/4	64 5/16	73 5/8	77 1/4	75	87 3/8
February	73 15/16	57 1/2	53 5/8	66 5/8	79 5/8	101 1/2	72 1/2	65 13/16	73 7/16	74 13/16	77 1/4	98
March	76	57 13/16	57 1/16	65 7/16	79 13/16	103 3/4	70 1/4	65 1/2	74 1/4	72 1/2	73 1/16	95 3/16
April	79	61 1/8	61 1/2	66 1/8	80 9/16	112 1/4	73 1/4	66 1/4	72 3/16	73 3/8	75 7/16	98 15/16
May	72 1/4	56 9/16	73 1/16	62 3/8	83 5/16	151	73 13/16	65 9/16	72 9/16	74 5/16	77 11/16	96 1/2
June	65 1/16	58 9/16	76 9/16	60 7/16	75 3/16	97 1/2	75 1/4	76 13/16	71 3/8	73 1/8	80 1/16	99
July	60 1/8	55 7/16	68	58 1/4	74	76 5/8	72	77 1/4	67 7/16	75 1/4	79 1/8	103 1/4
August	59 5/8	55	65 3/8	58 1/16	91 1/2	70 1/4	71 3/4	74	71 13/16	72 1/8	83 3/4	107
September	66 3/16	53	60 1/16	62 1/2	93 3/8	65 3/8	72 1/4	75 13/16	69 7/16	82 1/2	83 3/4	113 3/4
October	63 3/8	53 13/16	60 7/8	73 3/8	93 9/16	66 1/8	71 9/16	74 5/8	69 1/8	71 1/8	82 3/8	115 7/8
November	60 7/8	56 1/2	58 3/4	82 11/16	95 3/4	67	68 1/4	71 15/16	71 5/8	73 3/8	81	114 15/16
December	61 13/16	58 3/16	59 1/4	83 5/8	100 1/2	66 3/8	66 3/4	71 15/16	76 1/4	74 3/16	82 7/8	116 5/8
Yearly average	67 3/4	57 1/16	62 3/8	66 13/16	85 13/16	89 3/4	71 5/16	70 13/16	72	74 5/8	79 1/4	103 1/4

[a] This table exhibits average cash prices for the past twelve years. The monthly prices are the means between the lowest and highest prices for each month, and the yearly prices are the averages of the monthly averages.

OATS.

Oat crop of countries named, 1900–1904.

Countries.	1900.	1901.	1902.	1903.	1904.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States	809,126,000	736,809,000	987,843,000	784,094,000	894,596,000
Ontario	92,520,000	80,803,000	109,786,000	113,337,000	105,393,000
Manitoba	9,092,000	28,673,000	35,565,000	34,077,000	37,434,000
Rest of Canada	53,000,000	60,000,000	60,000,000	60,000,000	60,000,000
Total Canada	154,612,000	169,476,000	205,351,000	207,414,000	202,827,000
Total North America	963,738,000	906,285,000	1,193,194,000	991,508,000	1,097,423,000
Great Britain	118,467,000	113,576,000	134,493,000	128,611,000	131,423,000
Ireland	61,291,000	62,240,000	65,570,000	58,816,000	60,142,000
Total United Kingdom	179,758,000	175,816,000	200,063,000	187,427,000	191,565,000
Sweden	62,627,000	55,342,000	57,323,000	62,979,000	50,117,000
Denmark	40,323,000	37,409,000	40,822,000	41,176,000	40,000,000
Netherlands	17,296,000	18,485,000	19,241,000	20,112,000	19,000,000
Belgium	35,815,000	36,820,000	45,588,000	48,345,000	46,000,000
France	250,597,000	225,283,000	276,948,000	300,366,000	261,264,000
Spain	16,429,000	22,788,000	23,349,000	22,942,000	19,000,000
Italy	16,000,000	15,000,000	13,000,000	16,000,009	13,000,000
Germany	488,594,000	485,716,000	514,452,000	542,432,000	477,852,000
Austria	118,181,000	118,191,000	125,473,000	128,330,000	109,542,000
Hungary	70,637,000	68,083,000	82,807,000	87,334,000	62,775,000
Croatia-Slavonia	5,564,000	5,814,000	6,301,000	7,330,000	5,206,000
Total Austria-Hungary	194,382,000	192,088,000	214,581,000	222,994,000	177,523,000
Roumania	8,704,000	16,540,000	21,905,000	33,108,000	12,608,000
Bulgaria	6,000,000	8,000,000	10,000,000	15,000,000	8,000,000
Russia proper	744,037,000	527,576,000	807,888,000	650,405,000	967,100,000
Poland	51,235,000	56,150,000	63,167,000	58,745,000	44,393,000
North Caucasus	17,519,000	11,932,000	16,112,000	18,939,000	14,593,000
Total Russia in Europe	812,791,000	595,658,000	887,167,000	728,089,000	1,026,086,000
Total Europe	2,129,316,000	1,884,945,000	2,324,439,000	2,240,970,000	2,342,015,000
Siberia	34,918,000	21,569,000	34,078,000	60,352,000	46,937,000
Central Asia	5,987,000	6,870,000	9,433,000	11,342,000	8,011,000
Total Russia in Asia	40,905,000	28,439,000	43,511,000	71,694,000	54,948,000
Total Asia	40,905,000	28,439,000	43,511,000	71,694,000	54,948,000

Oat crop of countries named, 1900-1904—Continued.

Countries.	1900.	1901.	1902.	1903.	1904.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Algeria	5,000,000	5,000,000	8,729,000	6,000,000	6,616,000
Cape Colony	1,750,000	1,750,000	1,750,000	1,500,000	1,500,000
Total Africa	6,750,000	6,750,000	10,479,000	7,500,000	8,116,000
West Australia	76,000	90,000	164,000	173,000	267,000
South Australia	225,000	378,000	484,000	640,000	931,000
Queensland	11,000	8,000	44,000	1,000	73,000
New South Wales	648,000	612,000	709,000	363,000	1,292,000
Victoria	6,309,000	9,884,000	6,937,000	4,542,000	13,858,000
Tasmania	1,184,000	1,451,000	1,756,000	1,808,000	1,673,000
New Zealand	16,840,000	19,687,000	15,519,000	22,452,000	15,583,000
Total Australasia	25,293,000	32,110,000	25,613,000	29,979,000	33,677,000

RECAPITULATION BY CONTINENTS.

North America	963,738,000	906,285,000	1,193,194,000	991,508,000	1,097,423,000
Europe	2,129,816,000	1,884,945,000	2,324,439,000	2,240,970,000	2,342,015,000
Asia	40,905,000	28,439,000	43,511,000	71,694,000	54,948,000
Africa	6,750,000	6,750,000	10,479,000	7,500,000	8,116,000
Australasia	25,293,000	32,110,000	25,613,000	29,979,000	33,677,000
Total	3,166,002,000	2,858,529,000	3,597,236,000	3,341,651,000	3,536,179,000

Visible supply of oats in the United States and Canada, first of each month, for ten years.[a]

Month.	1895-1896.	1896-1897.	1897-1898.	1898-1899.	1899-1900.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	9,007,000	14,120,000	12,912,000	8,716,000	10,262,000
August	4,653,000	10,384,000	9,604,000	4,971,000	6,885,000
September	4,673,000	11,410,000	13,784,000	7,360,000	10,973,000
October	4,124,000	13,821,000	15,573,000	9,286,000	13,127,000
November	8,020,000	17,217,000	20,096,000	11,352,000	13,254,000
December	10,248,000	17,995,000	19,768,000	9,460,000	11,789,000
January	10,446,000	19,538,000	16,148,000	10,893,000	12,004,000
February	11,446,000	19,978,000	20,245,000	13,231,000	11,876,000
March	12,211,000	20,832,000	17,925,000	14,782,000	12,449,000
April	14,326,000	20,672,000	15,609,000	15,725,000	14,176,000
May	13,426,000	16,138,000	14,402,000	13,971,000	13,845,000
June	13,460,000	12,878,000	10,421,000	13,661,000	12,301,000

Month.	1900-1901.	1901-1902.	1902-1903.	1903-1904.	1904-1905.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	12,716,000	15,275,000	2,420,000	6,686,000	6,766,000
August	9,364,000	7,808,000	2,988,000	8,623,000	4,044,000
September	13,853,000	10,603,000	5,159,000	11,714,000	19,607,000
October	17,140,000	14,445,000	11,241,000	10,876,000	31,553,000
November	20,528,000	12,899,000	10,661,000	13,332,000	33,693,000
December	18,136,000	10,109,000	10,401,000	13,995,000	34,103,000
January	15,861,000	8,680,000	8,794,000	13,785,000	31,343,000
February	16,175,000	8,537,000	8,727,000	14,774,000	26,095,000
March	16,800,000	8,207,000	12,437,000	15,241,000	22,570,000
April	15,823,000	6,606,000	12,432,000	15,377,000	22,667,000
May	16,824,000	5,010,000	9,992,000	12,955,000	....
June	14,989,000	4,571,000	7,160,000	8,296,000	....

[a] These figures represent stocks available at 62 of the principal points of accumulation east of the Rocky Mountains, stocks in Manitoba elevators, and stocks afloat on lakes and canals, as reported by Bradstreet's.

Condition of the oat crop of the United States, monthly, 1887–1904.

Year.	June.	July.	August.	September.	Year.	June.	July.	August.	September.	Year.	June.	July.	August.	September.
1887....	91.0	85.9	85.6	83.4	1893...	88.9	88.8	78.3	74.9	1899...	88.7	90.0	90.8	87.2
1888....	95.4	95.2	91.7	87.2	1894...	87.0	77.7	76.5	77.8	1900...	91.7	85.5	85.0	82.9
1889....	93.8	91.1	92.3	90.0	1895...	84.3	83.2	84.5	86.0	1901...	85.3	83.7	73.6	72.1
1890....	89.8	81.6	70.1	64.4	1896...	98.8	96.3	77.3	74.0	1902...	90.6	92.1	89.4	87.2
1891....	85.1	87.6	89.5	90.7	1897...	89.0	87.5	86.0	84.6	1903...	85.5	84.3	79.5	75.7
1892....	88.5	87.2	86.2	78.9	1898...	98.0	92.8	84.2	79.0	1904...	89.2	89.8	86.6	85.6

Acreage, production, value, prices, exports, etc., of oats of the United States, 1866–1904.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1	Farm value, Dec. 1.	Chicago cash price per bushel, No. 2. December. Low.	Chicago cash price per bushel, No. 2. December. High.	Chicago cash price per bushel, No. 2. May of following year. Low.	Chicago cash price per bushel, No. 2. May of following year. High.	Domestic exports, including oatmeal, fiscal years beginning July 1.[a]	Imports during fiscal years beginning July 1.[a]
	Acres.	*Bush.*	*Bushels.*	*Cts.*	*Dollars.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Bushels.*	*Bushels.*
1866.....	8,864,219	30.2	268,141,077	35.1	94,057,945	36	43	59	78	825,895	778,198
1867.....	10,746,416	25.9	278,698,000	44.5	123,902,556	52	57¼	......	......	122,554	780,798
1868.....	9,665,736	26.4	254,960,800	41.7	106,355,976	43	49½	56¾	62½	481,871	326,659
1869.....	9,461,441	30.5	288,334,000	38.0	109,521,734	40	44¾	46½	53½	121,517	2,266,785
1870.....	8,792,395	28.1	247,277,400	39.0	96,443,637	37¾	41	47¼	51	147,572	599,514
1871.....	8,365,809	30.6	255,743,000	36.2	92,591,359	30¾	33	34¾	42½	262,975	535,250
1872.....	9,000,769	30.2	271,747,000	29.9	81,303,518	23½	25¾	30	34	714,072	225,555
1873.....	9,751,700	27.7	270,340,000	34.6	93,474,161	34	40⅝	44	48½	812,873	191,802
1874.....	10,897,412	22.1	240,369,000	47.1	113,133,934	51¾	54½	57¼	64½	504,770	1,500,040
1875.....	11,915,075	29.7	354,317,500	32.0	113,441,491	29½	30½	28⅝	31½	1,466,228	121,547
1876.....	13,358,908	24.0	320,884,000	32.4	103,844,896	31¾	34⅛	37¼	45¾	2,854,128	41,597
1877.....	12,826,148	31.7	406,394,000	28.4	115,546,194	24⅛	27	23	27	3,715,479	21,391
1878.....	13,176,500	31.4	413,578,560	24.6	101,752,468	19⅝	20⅜	24⅜	30½	5,452,136	13,395
1879.....	12,683,500	28.7	363,761,320	33.1	120,533,294	32¾	36¾	29½	34⅞	766,366	489,576
1880.....	16,187,977	25.8	417,885,380	36.0	150,243,565	29⅛	33½	36¼	39½	402,904	64,412
1881.....	16,831,600	24.7	416,481,000	46.4	193,198,970	43½	46¾	48¾	56⅜	625,690	1,850,983
1882.....	18,494,691	26.4	488,250,610	37.5	182,978,022	34¾	41½	38¾	42¾	461,496	815,017
1883.....	20,324,962	28.1	571,302,400	32.7	187,040,264	29⅜	36⅛	30¾	34¼	3,274,622	121,069
1884.....	21,300,917	27.4	583,628,000	27.7	161,528,470	22½	25¼	34½	37	6,203,104	94,310
1885.....	22,783,630	27.6	629,409,000	28.5	179,631,860	27	29	26¼	29⅝	7,311,306	149,480
1886.....	23,658,474	26.4	624,134,000	29.8	186,137,930	25¾	27¼	25⅛	27½	1,374,635	139,575
1887.....	25,920,906	25.4	659,618,000	30.4	200,699,790	28⅝	30⅞	32⅛	38	573,080	123,817
1888.....	26,998,282	26.0	701,735,000	27.8	195,424,240	25	26⅞	21⅝	23⅝	1,191,471	131,501
1889.....	27,462,316	27.4	751,515,000	22.9	171,781,008	20	21	24¾	30	15,107,238	153,232
1890.....	26,431,369	19.8	523,621,000	42.4	222,048,486	39⅞	43⅞	45¼	54	1,382,836	41,848
1891.....	25,581,861	28.9	738,394,000	31.5	232,312,267	31⅛	33⅝	28⅛	33½	10,586,644	47,782
1892.....	27,063,835	24.4	661,035,000	31.7	209,253,611	25⅝	31¼	28¾	32¼	2,700,793	49,433
1893.....	27,273,033	23.4	638,854,850	29.4	187,576,092	27⅛	29⅛	32½	36	6,290,229	31,759
1894.....	27,023,553	24.5	662,036,928	32.4	214,816,920	28¾	29⅜	27½	30¾	1,708,824	330,318
1895.....	27,878,406	29.6	824,443,537	19.9	163,655,068	16⅝	17⅛	18	19⅜	15,156,618	66,602
1896.....	27,565,985	25.7	707,346,440	18.7	132,485,033	16½	18¾	16⅞	18¾	37,725,083	131,204
1897.....	25,730,375	27.2	698,767,809	21.2	147,974,719	21	23⅞	26	32	73,880,307	25,093
1898.....	25,777,110	28.4	730,906,643	25.5	186,405,364	26	27¾	24	27¾	33,534,362	28,098
1899.....	26,341,380	30.2	796,177,713	24.9	198,167,975	22¼	23	21¼	23¾	45,048,857	54,576
1900.....	27,364,795	29.6	809,125,989	25.8	208,669,233	21¾	22¾	27⅞	31	42,268,931	32,107
1901.....	28,541,476	25.8	736,808,724	39.9	293,658,777	42	48¼	41	49½	13,277,612	38,978
1902.....	28,653,144	34.5	987,842,712	30.7	303,584,852	29¼	32	33⅞	38¼	8,381,805	150,065
1903.....	27,638,126	28.4	784,094,199	34.1	267,661,665	34¼	38	47¼	50	1,960,740	183,984
1904.....	27,842,669	32.1	894,595,552	31.3	279,900,013	43½	49	......	......	....	....

[a] In years 1866 to 1882, inclusive, oatmeal is not included.

The preceding table shows that the greatest area in oats, 28,653,144 acres, was reported in 1902; the greatest production, 987,842,712 bushels, in the same year; the greatest farm value on December 1, $303,584,852, in the same year; the greatest average production per acre, 34.5 bushels in the same year; the greatest average farm price per bushel on December 1, 47.1 cents in 1874. For the five years, 1900–1904, the average area was 28,008,042 acres; the average production, 842,493,435 bushels; the average farm value on December 1, $270,694,908; the average yield per acre, 30.1 bushels; the average farm price per bushel on December 1, 32.1 cents.

Acreage, production, value, and distribution of oats of the United States in 1904, by States.

States and Territories.	Crop of 1904.			Stock on hand Mar. 1, 1905.		Shipped out of county where grown.
	Acreage.	Production.	Value.			
	Acres.	*Bushels.*	*Dollars.*	*Bushels.*	*Per cent.*	*Bushels.*
Maine	113,957	4,170,826	1,876,872	1,501,497	36	41,708
New Hampshire	12,174	404,177	189,963	129,337	32	....
Vermont	80,129	3,036,889	1,336,231	1,214,756	40	....
Massachusetts	6,637	225,658	101,546	58,671	26	....
Rhode Island	1,604	40,742	19,149	13,037	32	....
Connecticut	10,077	337,580	148,535	77,643	23	....
New York	1,245,752	42,480,143	16,142,454	19,116,064	45	3,398,411
New Jersey	63,143	2,052,148	820,859	964,510	47	287,301
Pennsylvania	1,172,915	39,761,818	15,109,491	15,109,491	38	2,385,709
Delaware	4,341	122,416	50,191	25,707	21	12,242
Maryland	35,656	1,058,983	381,234	296,515	28	127,078
Virginia	183,811	3,878,412	1,667,717	1,396,228	36	271,489
North Carolina	205,874	3,252,809	1,691,461	813,202	25	97,584
South Carolina	191,336	3,271,846	1,963,108	458,058	14	229,029
Georgia	235,606	3,486,969	1,917,833	557,915	16	69,739
Florida	32,562	420,050	252,030	75,609	18	8,401
Alabama	197,787	2,947,026	1,591,394	471,524	16	29,470
Mississippi	101,544	1,949,645	1,013,815	565,397	29	19,496
Louisiana	31,494	579,490	260,770	81,129	14	....
Texas	896,510	28,688,320	12,622,861	5,737,664	20	7,458,963
Arkansas	211,276	4,795,965	2,062,265	1,390,830	29	143,879
Tennessee	155,779	3,286,937	1,216,167	1,150,428	35	460,171
West Virginia	85,606	2,259,998	994,399	836,199	37	180,800
Kentucky	228,553	5,485,272	2,194,109	1,919,845	35	438,822
Ohio	1,215,979	49,733,541	15,914,733	18,401,410	37	16,909,404
Michigan	990,002	32,175,065	10,617,771	13,191,777	41	8,687,268
Indiana	1,279,720	42,358,732	12,707,620	13,554,794	32	17,790,667
Illinois	3,666,936	117,341,952	35,202,586	41,069,683	35	61,017,815
Wisconsin	2,478,129	86,734,515	24,285,664	39,877,877	46	16,479,558
Minnesota	2,172,921	85,178,503	22,146,411	38,330,326	45	25,553,551
Iowa	3,822,600	122,323,200	30,580,800	48,929,280	40	45,259,584
Missouri	716,544	16,265,549	5,530,287	5,692,942	35	1,789,210
Kansas	952,533	16,955,087	5,595,179	5,425,628	32	1,356,407
Nebraska	1,886,270	57,908,489	14,477,122	26,637,905	46	24,900,650
South Dakota	713,468	27,825,252	6,956,313	11,964,858	43	7,234,566
North Dakota	829,154	31,010,360	7,442,486	16,745,594	54	5,891,968
Montana	167,207	6,303,704	2,899,704	2,143,259	34	1,891,111
Wyoming	41,787	1,261,967	492,167	378,590	30	100,957
Colorado	136,563	4,834,330	2,223,792	1,837,045	38	1,305,269
New Mexico	9,927	194,569	110,904	48,642	25	11,674
Arizona	999	30,070	22,252	6,916	23	....
Utah	44,966	1,690,722	794,639	422,680	25	557,938
Nevada	6,267	231,879	146,084	55,651	24	....
Idaho	92,778	3,646,175	1,823,088	838,620	23	1,640,779
Washington	164,971	7,407,198	3,185,095	1,703,656	23	2,814,735
Oregon	281,842	6,510,550	3,059,958	1,757,848	27	2,018,270
California	167,084	5,697,564	3,247,611	683,708	12	1,709,269
Oklahoma	283,117	6,002,080	2,160,749	1,740,603	29	780,270
Indian Territory	216,782	6,980,380	2,652,544	1,745,095	25	628,234
Total	27,842,669	894,595,552	279,900,013	347,165,643	38.8	261,989,446

Average yield per acre of oats in the United States, 1895–1904, by States.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	40.1	40.0	31.0	36.0	35.0	37.5	35.0	39.0	39.5	36.6
New Hampshire	36.9	38.0	35.0	33.0	35.0	32.6	29.5	35.0	31.1	33.2
Vermont	43.8	40.5	33.0	38.0	37.0	34.9	33.0	40.0	38.2	37.9
Massachusetts	36.0	36.0	32.0	32.0	33.0	36.8	31.0	32.2	31.7	34.0
Rhode Island	32.4	30.0	32.0	27.0	26.0	30.9	29.4	36.2	28.1	25.4
Connecticut	31.9	29.0	29.0	28.2	28.0	31.0	28.7	34.5	31.2	33.5
New York	31.7	33.0	31.0	27.5	31.0	27.9	21.6	40.0	34.0	34.1
New Jersey	35.5	34.0	25.0	19.6	24.0	29.6	16.0	32.2	25.4	32.5
Pennsylvania	31.7	31.0	28.2	23.3	33.0	31.1	18.9	36.5	28.6	33.9
Delaware	19.1	29.0	22.0	22.0	20.0	21.0	18.5	22.6	22.2	28.2
Maryland	26.2	24.0	24.0	19.5	23.0	24.0	18.8	26.7	20.6	29.7
Virginia	17.7	18.5	12.0	16.1	14.0	14.8	14.9	17.5	13.8	21.1
North Carolina	15.1	12.0	13.0	14.3	12.0	13.9	14.4	12.7	11.4	15.8
South Carolina	15.2	11.0	15.5	17.2	12.0	15.5	15.8	13.1	14.0	17.1
Georgia	14.5	12.0	14.0	16.6	9.0	15.0	14.8	11.1	13.6	14.8
Florida	10.2	12.0	9.0	15.4	9.0	11.3	13.1	13.6	13.2	12.9
Alabama	14.9	14.0	13.0	16.8	10.0	14.4	14.5	10.9	15.8	14.9
Mississippi	15.7	13.0	14.0	18.5	10.0	14.0	15.2	15.4	15.0	19.2

Average yield per acre of oats in the United States, 1895–1904, by States—Continued.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Louisiana	15.0	16.0	18.0	18.1	18.0	18.0	13.4	15.2	15.9	18.4
Texas	20.7	20.0	25.0	29.7	25.0	38.0	16.3	23.2	35.5	32.0
Arkansas	25.4	16.0	17.0	22.8	19.0	22.2	12.3	20.0	18.6	22.7
Tennessee	22.5	16.5	10.0	18.7	14.0	16.6	17.5	17.3	18.5	21.1
West Virginia	23.4	24.0	20.0	19.5	23.0	21.0	18.7	28.6	21.7	26.4
Kentucky	26.2	21.0	18.0	22.4	18.0	21.3	19.7	22.2	20.1	24.0
Ohio	31.7	31.0	32.0	30.9	36.0	38.0	31.5	41.1	30.6	40.9
Michigan	23.9	30.0	26.0	32.8	34.0	36.7	29.0	39.9	30.5	32.5
Indiana	22.9	29.0	30.2	29.2	32.0	32.7	28.6	35.4	24.4	33.1
Illinois	24.4	28.0	32.0	29.0	38.0	38.0	28.2	37.7	26.6	32.0
Wisconsin	33.8	33.4	34.0	36.1	36.0	32.0	29.1	39.9	32.8	35.0
Minnesota	39.9	33.0	26.0	36.3	32.0	25.2	32.1	39.0	32.3	39.2
Iowa	46.2	27.5	30.0	34.0	33.0	34.0	29.8	30.7	24.0	32.0
Missouri	27.7	18.0	22.0	17.0	25.0	27.4	11.2	32.5	22.1	22.7
Kansas	17.9	13.0	24.0	18.0	29.0	31.6	18.6	33.5	26.2	17.8
Nebraska	23.8	19.0	31.0	32.1	30.0	21.8	19.8	34.6	29.5	30.7
South Dakota	25.3	27.5	22.0	26.8	26.0	21.5	28.8	34.8	38.6	39.0
North Dakota	32.1	22.0	23.0	30.7	30.0	10.3	32.6	38.4	27.4	37.4
Montana	35.8	47.0	42.0	40.6	38.0	39.0	42.0	41.9	46.4	37.7
Wyoming	41.0	32.0	35.0	31.2	30.0	34.2	41.0	36.0	29.4	30.2
Colorado	34.3	28.0	34.0	35.8	27.0	32.8	33.8	26.8	33.3	35.4
New Mexico	39.9	27.0	35.5	38.8	24.0	30.1	31.6	19.1	22.6	19.6
Arizona	......	......	......	......	......	......	35.0	31.7	35.5	30.1
Utah	33.8	38.0	35.0	39.7	34.0	35.9	33.0	35.5	36.4	37.6
Nevada	......	......	......	......	......	......	43.0	34.8	28.6	37.0
Idaho	35.2	42.0	36.3	43.6	34.0	36.6	38.3	42.1	41.5	39.3
Washington	40.3	36.0	48.0	41.9	37.0	34.4	47.5	46.2	47.9	44.9
Oregon	28.8	21.0	32.0	27.0	30.0	18.5	31.5	28.7	33.8	23.1
California	28.1	31.0	18.0	33.0	31.0	24.6	30.4	30.5	34.8	34.1
Oklahoma	......	......	......	......	......	......	20.7	47.8	26.4	21.2
Indian Territory	......	......	......	......	......	......	25.0	32.6	30.0	32.2
General average	29.6	25.7	27.2	28.4	30.2	29.6	25.8	34.5	28.4	32.1

Average yield of oats in certain countries, in bushels per acre, 1894–1903.

Year.	United States.	Russia.	Germany.	Austria.	Hungary.	France.	United Kingdom.
	(*a*)	(*b*)	(*b*)	(*b*)	(*b*)	(*a*)	(*a*)
1894	24.5	21.7	46.8	25.9	30.1	27.2	43.7
1895	29.6	19.9	43.2	26.2	29.6	27.5	39.5
1896	25.7	19.2	41.8	23.1	31.4	27.0	39.2
1897	27.2	15.7	39.9	21.5	24.3	23.1	40.1
1898	28.4	16.5	47.1	27.3	30.2	29.0	43.6
1899	30.2	23.6	48.0	30.2	33.3	27.8	41.8
1900	29.6	19.5	48.0	25.2	28.1	25.7	41.2
1901	25.8	14.0	44.5	25.6	28.1	23.5	40.6
1902	34.5	21.8	50.2	27.6	34.0	29.2	45.9
1903	28.4	17.7	51.3	28.4	34.4	31.6	44.2
Average	28.4	19.0	46.1	26.1	30.3	27.2	42.0

a Winchester bushels. *b* Bushels of 32 pounds.

Average value per acre of oats in the United States, based upon farm value December 1, 1895–1904, by States.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Maine	$13.63	$12.40	$9.92	$12.24	$13.30	$14.25	$17.50	$17.55	$17.77	$16.47
New Hampshire	12.92	13.30	13.30	12.54	13.65	12.39	15.34	15.40	14.93	15.60
Vermont	14.37	12.56	10.56	13.30	13.69	12.56	16.50	17.20	16.81	16.68
Massachusetts	12.24	12.60	10.56	11.84	12.54	13.98	17.05	14.49	15.53	15.30
Rhode Island	12.64	9.30	10.88	9.99	9.62	11.74	15.88	15.57	12.65	11.94
Connecticut	9.89	8.99	9.86	10.15	10.36	10.85	15.50	14.14	14.04	14.74
New York	8.88	8.58	8.37	8.53	10.23	8.93	10.37	14.40	13.94	12.96
New Jersey	10.29	9.52	7.50	6.08	7.92	9.18	7.52	12.56	10.92	13.00
Pennsylvania	8.56	7.43	7.61	6.99	9.57	9.33	8.50	12.41	10.58	12.88
Delaware	5.54	6.09	5.06	6.60	5.00	6.30	8.33	9.49	8.88	11.56
Maryland	7.07	5.52	6.24	5.65	6.90	7.44	7.71	10.15	8.24	10.69
Virginia	5.31	4.81	3.48	4.67	4.62	5.48	6.26	7.35	5.93	9.07

Average value per acre of oats in the United States, based upon farm value December 1, 1895–1904, by States—Continued.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
North Carolina	$5.74	$4.20	$4.81	$5.29	$4.92	$6.26	$7.34	$6.48	$5.93	$8.22
South Carolina	7.45	5.28	6.98	7.74	5.64	7.44	9.80	7.73	8.26	10.26
Georgia	6.67	4.92	5.88	7.97	4.32	7.35	9.92	5.88	7.48	8.14
Florida	6.63	6.36	4.77	8.32	4.50	5.65	9.43	8.30	7.92	7.74
Alabama	6.26	5.74	5.59	6.89	4.30	6.34	9.28	6.00	8.53	8.05
Mississippi	6.12	5.72	6.16	7.77	5.00	6.44	9.58	7.85	7.65	9.98
Louisiana	5.40	3.40	6.84	6.88	7.20	7.20	8.04	7.60	7.31	8.28
Texas	5.38	6.80	6.75	8.32	7.50	11.40	9.78	11.37	15.62	14.08
Arkansas	8.13	4.96	5.61	6.61	6.46	7.77	7.01	8.20	8.18	9.76
Tennessee	6.08	4.29	2.80	5.24	4.48	5.81	7.87	7.27	7.77	7.80
West Virginia	7.49	6.72	6.00	5.85	8.05	7.14	8.04	11.73	9.98	11.62
Kentucky	6.81	5.04	4.86	6.05	5.76	6.60	8.08	7.99	8.24	9.60
Ohio	6.97	5.27	6.40	7.42	9.00	9.88	12.28	13.15	11.02	13.09
Michigan	5.50	5.70	5.98	8.86	9.52	9.54	11.89	13.17	10.98	10.72
Indiana	4.58	4.64	5.74	6.72	7.36	7.52	10.87	9.91	7.81	9.93
Illinois	4.15	4.20	5.76	6.67	8.36	8.74	11.28	10.56	8.51	9.60
Wisconsin	6.08	5.95	6.46	8.66	8.28	7.36	11.35	11.97	11.15	9.80
Minnesota	5.59	4.95	4.94	7.62	7.04	6.05	10.91	10.53	9.69	10.19
Iowa	6.47	3.30	4.80	8.16	6.27	6.80	10.73	7.67	6.96	8.00
Missouri	4.99	3.06	4.18	3.91	6.00	6.30	4.82	9.10	7.07	7.72
Kansas	3.04	2.08	4.32	3.96	6.38	7.27	8.00	10.05	7.86	5.87
Nebraska	3.33	2.09	4.65	6.42	6.60	5.23	7.33	8.65	7.97	7.67
South Dakota	4.35	3.58	3.96	5.63	5.98	5.16	9.79	10.09	11.19	9.75
North Dakota	5.14	3.96	5.98	7.98	8.10	3.30	10.76	10.37	8.49	8.98
Montana	15.75	14.57	13.86	14.21	14.82	16.38	15.12	15.08	16.24	17.34
Wyoming	15.99	16.96	12.25	12.48	12.00	16.07	19.68	18.00	14.70	11.78
Colorado	9.60	8.40	10.88	14.68	11.34	14.10	16.90	13.67	13.65	16.28
New Mexico	17.96	10.80	14.56	15.91	10.56	14.45	18.96	12.99	14.01	11.17
Arizona	......	......	......	......	......	......	21.00	23.78	21.65	22.27
Utah	10.14	14.82	11.55	15.09	13.60	15.80	16.83	16.68	17.84	17.67
Nevada	......	......	......	......	......	......	30.10	24.36	19.45	23.31
Idaho	10.21	12.60	11.62	15.70	12.92	14.64	16.85	20.21	18.68	19.65
Washington	11.28	14.40	16.80	16.76	14.06	13.76	16.63	22.64	18.20	19.31
Oregon	7.78	6.93	11.20	10.80	12.30	7.59	10.71	11.77	14.87	10.86
California	10.96	13.64	8.82	16.50	14.57	11.32	13.38	15.55	18.79	19.44
Oklahoma	......	......	......	......	......	......	10.35	16.25	8.98	7.63
Indian Territory	......	......	......	......	......	......	11.50	12.06	10.50	12.24
General average	5.87	4.81	5.75	7.23	7.52	7.63	10.29	10.60	9.68	10.05

Average farm price of oats per bushel in the United States December 1, 1895–1904, by States.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	34	31	32	34	38	38	50	45	45	45
New Hampshire	35	35	38	38	39	38	52	44	48	47
Vermont	33	31	32	35	37	36	50	43	44	44
Massachusetts	34	35	33	37	38	38	55	45	49	45
Rhode Island	39	31	34	37	37	38	54	43	45	47
Connecticut	31	31	34	36	37	35	54	41	45	44
New York	28	26	27	31	33	32	48	36	41	38
New Jersey	29	28	30	31	33	31	47	39	43	40
Pennsylvania	27	24	27	30	29	30	45	34	37	38
Delaware	29	21	23	30	25	30	45	42	40	41
Maryland	27	23	26	29	30	31	41	38	40	36
Virginia	30	26	29	29	33	37	42	42	43	43
North Carolina	38	35	37	37	41	45	51	51	52	52
South Carolina	49	48	45	45	47	48	62	59	59	60
Georgia	46	41	42	48	48	49	67	53	55	55
Florida	65	53	53	54	50	50	72	61	60	60
Alabama	42	41	43	41	43	44	64	55	54	54
Mississippi	39	44	44	42	50	46	63	51	51	52
Louisiana	36	34	38	38	40	40	60	50	46	45
Texas	26	34	27	28	30	30	60	49	44	44
Arkansas	32	31	33	29	34	35	57	41	44	43
Tennessee	27	26	28	28	32	35	45	42	42	37
West Virginia	32	28	30	30	35	34	43	41	46	44
Kentucky	26	24	27	27	32	31	41	36	41	40
Ohio	22	17	20	24	25	26	39	32	36	32
Michigan	23	19	23	27	28	26	41	33	36	38
Indiana	20	16	19	23	23	23	38	28	32	30
Illinois	17	15	18	23	22	23	40	28	32	30
Wisconsin	18	17	19	24	23	23	39	30	34	28
Minnesota	14	15	19	21	22	24	34	27	30	26
Iowa	14	12	16	24	19	20	36	25	29	25

Average farm price of oats per bushel in the United States December 1, 1895–1904, by States—Continued.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Missouri	18	17	19	23	24	23	43	28	32	34
Kansas	17	16	18	22	22	23	43	30	30	33
Nebraska	14	11	15	20	22	24	37	25	27	25
South Dakota	17	13	18	21	23	24	34	29	29	25
North Dakota	16	18	26	26	27	32	33	27	31	24
Montana	44	31	33	35	39	42	36	36	35	46
Wyoming	39	53	35	40	40	47	48	50	50	39
Colorado	28	30	32	41	42	43	50	51	41	46
New Mexico	45	40	41	41	44	48	60	68	62	57
Arizona	......	......	......	......	......	......	60	75	61	74
Utah	30	39	33	38	40	44	51	47	49	47
Nevada	......	......	......	......	......	......	70	70	68	63
Idaho	29	30	32	36	38	40	44	48	45	50
Washington	28	40	35	40	38	40	35	49	38	43
Oregon	27	33	35	40	41	41	34	41	44	47
California	39	44	49	50	47	46	44	51	54	57
Oklahoma	......	......	......	......	......	......	50	34	34	36
Indian Territory	......	......	......	......	......	......	46	37	35	38
General average	19.9	18.7	21.2	25.5	24.9	25.8	39.9	30.7	34.1	31.3

Transportation rates, average for oats in sacks, in cents per 100 pounds, St. Louis to New Orleans, by river.

1884	14.00	1891	16.28	1898	10.00
1885	15.00	1892	16.87	1899	10.00
1886	16.00	1893	17.54	1900	10.00
1887	18.25	1894	17.14	1901	10.00
1888	15.00	1895	13.00	1902	10.00
1889	17.93	1896	14.54	1903	10.00
1890	15.66	1897	10.83	1904	(a)

[a] No shipment.

American Oatmeal in Canada.

Under date of Halifax, Nova Scotia, December 8, 1904, United States Consul-General Holloway transmitted the following extract from the Halifax Maritime Merchant:

Several carloads of United States oatmeal have lately been dumped on the Canadian market. Unfortunately for the Canadian miller this can not under present conditions be prevented, and has to be met by a reduction in the prices of the domestic product. In the United States there has been a bumper oat crop, while in Canada the crop has been quite small, so the American miller has been able to send his oatmeal into the Canadian market and, after paying the duty of 64 cents, is able to undersell the Canadian article by 25 cents a barrel. The market at present is unsettled in consequence.

New Cereal Industry in Canada.

Consul Worman, Three Rivers, Canada, reported on January 31, 1905, that French and Italian parties contemplate manufacturing in Canada, on a large scale, all kinds of pastry food, but particularly macaroni. As the present output of macaroni in the United States consumes 3,000 barrels of flour daily, such a project should have the attention of those engaged in the milling industry.

Wholesale prices of oats per bushel in leading cities of the United States, 1899–1904.

Date.	New York.		Baltimore.		Cincinnati.		Chicago.		Milwaukee.		Duluth.		Detroit.		San Francisco.	
	No. 2, mixed.		No. 2, mixed.		No. 2, mixed.		No. 2.		No. 2, white.		No. 2.		No. 2, white.		No. 1, white (per cwt.).	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1899.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*		
January	33	35	32	33½	28½	31	26¼	27¾	28¼	31¼	28¾	30½	30½	33	$1.30	$1.30
February	34¼	35½	33	35	28¾	31½	26¾	28¼	29½	31½	28¼	30	32½	33	1.30	1.32½
March	32	35¼	32	34	28½	31	25¼	27¾	28¾	31	25¾	29¼	31	32¾	1.35	1.40
April	32½	33½	32	33	29	30½	26⅜	27¼	29½	31	27¼	28	32¼	33	1.40	1.40
May	31	32½	29½	33	27½	29½	24	27¾	26¾	31	26⅛	28	30¼	32¾	1.42½	1.45
June	30½	31½	29½	31	27	29	24¼	26¼	26¾	29¼	26⅛	28½	28¾	30¼	1.42½	1.45
July	28	30½	28½	31	22	28½	19⅞	25	24	28	22⅛	26¾	25½	30	1.35	1.40
August	26	27½	24½	29	21½	22½	19¼	22	23	26	19½	23¼	23½	25½	1.27½	1.35
September	25¾	29	25	28	22½	25½	21	23¼	22¾	26	20¼	24	23¾	28½	1.17½	1.22½
October	28½	29¼	27½	29	24¾	26	22	23⅛	24¾	26	22¼	24¾	26	27½	1.20	1.25
November	28½	30	27⅛	29½	25¼	26½	22½	24	25¼	26½	22⅛	23¾	27	28	1.25	1.25
December	28½	30	28	29½	25½	26¾	22¼	23	24¾	25½	22⅛	23¼	26½	27½	1.25	1.25
1900.																
January	29	29¾	28	29½	25¼	26½	22½	23	25	26	23	24	26¼	28½	1.25	1.30
February	29	29½	28¾	29½	25¼	26	22½	23¾	25	26	24	24	27¼	28½	1.25	1.25
March	28½	29½	28	29½	25¼	26½	23	24½	25	27	24	24	27¼	28½	1.25	1.26¼
April	27½	29½	27¾	29¼	26	28	23	25¼	26½	29	24	24½	28¼	29	1.25	1.26¼
May	26	28	26½	28¼	24½	26½	21¼	23¾	24	27½	23	24½	27	28½	1.22½	1.25
June	26	29¾	26	29	24	27	21¾	26¼	24¼	28½	23	28	26	29¼	1.22½	1.25
July	26½	29	27	28½	25	28	21½	24¾	24¾	28½	23¾	28	28	28½	1.25	1.30
August	25½	26½	24	27	21	25	21	22⅝	24½	27¼	23¼	24½	24½	28	1.27½	1.30
September	24¾	25½	24½	25¾	22¼	23½	21⅛	22¼	24¾	26	22½	23¾	24¾	26	1.27½	1.27½
October	25	26	24¾	25½	23	24	21⅜	22⅝	24¾	26	23¼	24	25¼	26	1.30	1.32½
November	25½	26¾	24¾	26	23	25	21¾	22⅛	24¾	26¼	23¼	23¼	24	26½	1.35	1.35
December	26½	28½	26	29	24	25½	21¾	22¾	25½	26¼	23½	24¾	27	28	1.35	1.40
1901.																
January	28¼	31	28	29	25	27½	23¼	24¼	25½	27½	25¼	26¼	28	28½	1.17½	1.45
February	30	31	28	30	26¾	28	24⅛	25½	27	28¼	26¼	26¾	28½	30	1.20	1.42½
March	30½	31½	29¾	31	27½	28	24¾	26½	27½	28¾	25¼	27¼	29	29¾	1.20	1.45
April	30¾	32	30½	32	28	29	25½	27½	27¾	30½	27	27¼	30	31	1.25	1.50
May	32¼	34	31	32	30	32	27⅞	31	29	30½	27¼	29¼	30½	32½	1.30	1.45
June	32	33	31½	32½	29½	30½	27	28¾	28¾	29¾	27¼	28¼	30	31½	1.40	1.55
July	33⅛	41½	31½	42	31½	42	27½	39	30¾	41½	27¼	36¼	31½	40½	1.15	1.40
August	38	40½	37¼	42½	37	38	33½	37½	36¾	39½	34⅞	37½	54½	60½	1.10	1.35
September	38	39½	37½	38½	36	38	33⅝	36¾	36¼	38¾	35⅛	37½	36¼	39½	1.10	1.30
October	38	42	38	41½	38	39	34½	37¾	36	40½	35¼	37⅛	38½	40½	1.02½	1.30
November	42½	49	41	49	40	46	37⅛	44⅛	41	46	36⅞	43¼	41½	48½	1.10	1.30
December	49	52	48½	53	47	50¾	42	48¼	45¾	48¾	42¾	46⅞	48½	51	1.20	1.42½

1902.																
January	46½	53	48	52	46	50	38⅛	46¼	44¼	49	40⅜	47⅛	45	50½	1.25	1.40
February	48	50	47	49½	46	48	40¾	44¼	42¾	47	38⅝	43¼	46	47½	1.27½	1.42½
March	46¾	52	47½	49	45½	47	40¼	45½	44	47	40	43	46	48¼	1.25	1.40
April	46½	49½	47½	49	44	46½	41	44½	43¾	47¼	40	46⅛	46	48½	1.27½	1.45
May	45½	48	47½	48½	44	46	41	49½	44¼	46	42⅛	45⅝	46	48½	1.35	1.50
June	44½	55	47½	55	43	52	39	48½	43	54	28¾	34	46½	57	1.35	1.50
July	55	64¾	54	60	32½	57	30	56	51½	58	30½	34½	57	61	1.20	1.35
August	34½	65	31	59	27	31	25	31	33¼	58	27½	30	34¾	60	1.15	1.30
September	32	35	29	32	28½	31½	26⅛	27¼	31⅛	35	29	31½	36¼	39½	1.17½	1.30
October	33	34½	29½	33½	30	32	27¼	30	32	34	29½	32	38½	41¼	1.15	1.32½
November	34	36	32½	35½	29¾	34	27¾	29½	30½	34	28½	32	41¼	48	1.20	1.35
December	36	38¼	35½	40	33	39	29¼	32	32½	34	31	32	48½	51	1.25	1.40
1903.																
January	38½	44	39½	42½	35	39	31¾	34½	33½	36¾	32½	34½	36	38	1.22½	1.35
February	42½	43¾	39½	41	37½	39½	33½	36	36	36¾	34	35½	38	40	1.22½	1.37½
March	42	44½	40	41½	37	39	31¼	34⅜	36	36	31	34½	38	39	1.22½	1.32½
April	38	42	38	41½	33½	37	32⅛	35¾	36	36¾	32½	33½	36½	38½	1.20	1.32½
May	38	39½	37½	39	33	37½	33⅜	38¼	36	38	33½	35½	37	39	1.20	1.30
June	39¾	43¾	38½	44	36	43½	35½	43¼	36½	40½	35	40	39	45	1.17½	1.27½
July	40	43	36½	44	31½	41½	33½	45	36½	41	32½	37½	36	41½	1.17½	1.30
August	38	40½	34½	39	33	35¼	33⅝	36¾	37	38½	34	35½	35½	36¾	1.17½	1.32½
September	38	42	39	41½	35	39	35½	38	37	40	35¾	38⅜	37½	40	1.17½	1.32½
October	40½	42	40	41	36½	39	34½	38½	37½	39	35	37½	38½	39¾	1.20	1.32½
November	40	42	38½	40½	35½	37½	33¼	38½	36½	38½	32⅝	35¼	36½	38½	1.25	1.32½
December	40½	42½	39	40½	37	39	34¼	38	37½	38	34¼	35⅞	37½	39	1.25	1.32½
1904.											No. 3.		No. 3, white.			
January	42½	45½	41	43½	38	42½	36½	41½	35	41	35½	39½	39	42½	1.25	1.37½
February	46	55½	43	48	41½	44½	39⅜	46	40	44½	38⅞	42⅞	42¼	48¼	1.25	1.37½
March	46	55½	45½	47½	41	44½	38	42¾	39	44	38¼	40⅜	44	46½	1.27½	1.37½
April	43½	47	43	46½	40	43	36⅛	41⅞	37	43¾	37¼	41	42½	45¼	1.27½	1.40
May	45½	47	43½	45½	41½	42½	39⅝	44¾	41	45	40	43	45	45¾	1.32½	1.50
June	44¾	46	43½	45¼	41	44	39¾	42¼	38	44	40	42½	42½	46½	1.40	1.50
July	41	45	43½	45½	40	41½	38½	45	37	41	36	38	41½	44	1.30	1.50
August	35½	43	34½	45	32½	40½	31½	40	31¾	42	32¼	38	33	43½	1.30	1.50
September	34½	36	33	35	33	34½	29⅝	33½	29½	33½	30	32⅜	32	33½	1.40	1.52½
October	34½	36	33	34	31½	33½	28¼	31½	28½	33	27¾	30⅝	31⅞	34	1.40	1.55
November	35	35	33	35¾	31	33½	29	32¼	29½	32	29	29⅝	32	32½	1.45	1.60
December	34½	36½	35½	36	32¾	33¾	28¼	32	29	32	28¼	29⅝	32½	33½	1.45	1.60

Monthly average prices of oats in Chicago. [a]

[Cents per bushel.]

Month.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
January	31	$28\frac{1}{4}$	$28\frac{7}{8}$	$18\frac{3}{4}$	$16\frac{3}{8}$	$22\frac{3}{4}$	27	$22\frac{3}{4}$	$23\frac{7}{8}$	$42\frac{3}{16}$	$33\frac{1}{8}$	39
February	$30\frac{3}{4}$	$28\frac{3}{8}$	$28\frac{1}{4}$	$19\frac{15}{16}$	$16\frac{1}{8}$	$25\frac{1}{2}$	$27\frac{1}{2}$	$23\frac{1}{8}$	$24\frac{13}{16}$	$42\frac{1}{2}$	$34\frac{3}{4}$	$42\frac{11}{16}$
March	$29\frac{15}{16}$	$30\frac{1}{16}$	$29\frac{3}{8}$	$19\frac{1}{4}$	$16\frac{1}{2}$	$25\frac{13}{16}$	$26\frac{1}{2}$	$23\frac{3}{4}$	$25\frac{5}{8}$	$42\frac{7}{8}$	$32\frac{13}{16}$	$40\frac{5}{8}$
April	$27\frac{15}{16}$	$32\frac{1}{8}$	$29\frac{1}{16}$	$19\frac{1}{8}$	$17\frac{1}{8}$	$28\frac{7}{16}$	$26\frac{13}{16}$	$24\frac{1}{8}$	$26\frac{1}{2}$	$42\frac{3}{4}$	$33\frac{15}{16}$	39
May	$30\frac{1}{4}$	$34\frac{1}{2}$	$29\frac{9}{16}$	$18\frac{13}{16}$	$17\frac{13}{16}$	29	$25\frac{7}{8}$	$22\frac{1}{2}$	$29\frac{7}{16}$	$45\frac{1}{4}$	$35\frac{13}{16}$	$42\frac{3}{16}$
June	$29\frac{3}{8}$	42	$28\frac{3}{16}$	$16\frac{7}{8}$	$18\frac{1}{8}$	$23\frac{3}{4}$	$25\frac{1}{4}$	24	$27\frac{7}{8}$	$43\frac{3}{4}$	$39\frac{5}{8}$	41
July	$26\frac{3}{16}$	$38\frac{3}{16}$	$23\frac{7}{8}$	$16\frac{3}{4}$	$17\frac{9}{16}$	$23\frac{3}{8}$	$22\frac{7}{16}$	$23\frac{1}{8}$	$33\frac{1}{4}$	43	$39\frac{1}{4}$	$41\frac{3}{4}$
August	$23\frac{1}{8}$	$30\frac{1}{8}$	$20\frac{7}{8}$	$17\frac{1}{8}$	$18\frac{3}{16}$	$21\frac{3}{8}$	$20\frac{5}{8}$	$21\frac{13}{16}$	$35\frac{1}{2}$	28	$35\frac{3}{16}$	$35\frac{1}{4}$
September	$26\frac{5}{16}$	$29\frac{5}{16}$	$19\frac{1}{4}$	16	$19\frac{13}{16}$	$21\frac{5}{16}$	$22\frac{1}{8}$	$21\frac{11}{16}$	$35\frac{3}{16}$	$26\frac{11}{16}$	$36\frac{3}{4}$	$31\frac{9}{16}$
October	$27\frac{1}{8}$	$28\frac{1}{2}$	$18\frac{1}{4}$	$18\frac{5}{16}$	$18\frac{3}{4}$	$23\frac{1}{4}$	$22\frac{3}{4}$	22	$36\frac{1}{8}$	$28\frac{5}{8}$	$36\frac{1}{8}$	$29\frac{7}{16}$
November	$28\frac{1}{4}$	$29\frac{1}{8}$	$18\frac{1}{2}$	$18\frac{5}{8}$	$20\frac{7}{8}$	26	$23\frac{1}{4}$	$22\frac{1}{8}$	$40\frac{5}{8}$	$28\frac{5}{8}$	$35\frac{7}{8}$	$30\frac{3}{8}$
December	$28\frac{1}{8}$	$29\frac{1}{2}$	$17\frac{5}{16}$	$17\frac{5}{8}$	$22\frac{7}{16}$	$26\frac{7}{8}$	$22\frac{5}{8}$	$22\frac{1}{4}$	$45\frac{1}{8}$	$30\frac{5}{8}$	$36\frac{1}{8}$	$30\frac{1}{8}$
Yearly average	$28\frac{1}{4}$	$31\frac{3}{4}$	$24\frac{1}{4}$	$18\frac{1}{16}$	$18\frac{1}{4}$	$24\frac{3}{4}$	$24\frac{3}{8}$	$22\frac{3}{4}$	32	$37\frac{1}{16}$	$35\frac{13}{16}$	37

[a] This table exhibits average cash prices for the past twelve years. The monthly prices are the means between the lowest and highest prices for each month, and the yearly prices are the averages of the monthly averages.

BARLEY.

Barley crop of countries named, 1900–1904.

Countries.	1900.	1901.	1902.	1903.	1904.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States	58, 926, 000	109, 933, 000	134, 954, 000	131, 861, 000	139, 749, 000
Ontario	17, 443, 000	17, 289, 000	22, 580, 000	25, 147, 000	25, 342, 000
Manitoba	3, 032, 000	6, 742, 000	12, 222, 000	8, 982, 000	11, 530, 000
Rest of Canada	3, 500, 000	4, 500, 000	5, 000, 000	5, 000, 000	7, 000, 000
Total Canada	23, 975, 000	28, 531, 000	39, 802, 000	39, 129, 000	43, 872, 000
Mexico	10, 529, 000	7, 727, 000	6, 045, 000	9, 000, 000	9, 000, 000
Total North America	93, 430, 000	146, 191, 000	180, 801, 000	179, 990, 000	192, 621, 000
Great Britain	64, 278, 000	63, 033, 000	68, 590, 000	61, 348, 000	58, 996, 000
Ireland	6, 485, 000	6, 808, 000	8, 273, 000	6, 076, 000	5, 478, 000
Total United Kingdom	70, 763, 000	69, 841, 000	76, 863, 000	67, 424, 000	64, 474, 000
Sweden	13, 821, 000	12, 753, 000	12, 283, 000	14, 653, 000	14, 159, 000
Denmark	22, 826, 000	22, 283, 000	23, 287, 000	23, 340, 000	22, 500, 000
Netherlands	4, 583, 000	3, 876, 000	4, 652, 000	3, 823, 000	4, 000, 000
Belgium	4, 754, 000	4, 650, 000	4, 974, 000	3, 923, 000	4, 500, 000
France	40, 847, 000	38, 857, 000	41, 948, 000	43, 345, 000	38, 827, 000
Spain	56, 716, 000	79, 834, 000	81, 279, 000	64, 359, 000	60, 000, 000
Italy	7, 000, 000	8, 000, 000	6, 000, 000	8, 000, 000	7, 000, 000
Germany	137, 889, 000	152, 537, 000	142, 392, 000	152, 653, 000	135, 409, 000
Austria	61, 480, 000	67, 091, 000	73, 788, 000	73, 873, 000	66, 598, 000
Hungary	53, 877, 000	50, 071, 000	62, 350, 000	64, 577, 000	49, 915, 000
Croatia-Slavonia	2, 902, 000	3, 051, 000	3, 259, 000	3, 839, 000	2, 938, 000
Total Austria-Hungary	118, 259, 000	120, 213, 000	139, 397, 000	142, 289, 000	119, 451, 000
Roumania	14, 618, 000	24, 222, 000	24, 586, 000	29, 716, 000	11, 567, 000
Bulgaria	10, 000, 000	9, 500, 000	11, 000, 000	19, 000, 000	12, 000, 000
Russia proper	187, 230, 000	189, 435, 000	274, 899, 000	289, 699, 000	288, 110, 000
Poland	18, 415, 000	20, 640, 000	22, 185, 000	20, 819, 000	17, 705, 000
North Caucasus	27, 105, 000	25, 685, 000	35, 530, 000	39, 980, 000	31, 254, 000
Total Russia in Europe	232, 750, 000	235, 760, 000	332, 614, 000	350, 498, 000	337, 069, 000
Total Europe	734, 826, 000	782, 326, 000	901, 275, 000	923, 023, 000	830, 956, 000
Siberia	2, 969, 000	2, 003, 000	2, 628, 000	4, 213, 000	4, 661, 000
Central Asia	1, 262, 000	2, 154, 000	3, 008, 000	2, 759, 000	2, 251, 000
Total Russia in Asia	4, 231, 000	4, 157, 000	5, 636, 000	6, 972, 000	6, 912, 000
Japan	82, 697, 000	83, 352, 000	74, 321, 000	82, 000, 000	80, 000, 000
Total Asia	86, 928, 000	87, 509, 000	79, 957, 000	88, 972, 000	86, 912, 000

Barley crop of countries named, 1900–1904—Continued.

Countries.	1900.	1901.	1902.	1903.	1904.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Algeria	35,000,000	35,000,000	47,906,000	46,000,000	37,106,000
Tunis	4,908,000	3,449,000	3,201,000	11,322,000	14,815,000
Cape Colony	800,000	700,000	800,000	700,000	800,000
Total Africa	40,708,000	39,149,000	51,907,000	58,022,000	52,721,000
West Australia	58,000	30,000	37,000	48,000	55,000
South Australia	195,000	218,000	251,000	327,000	503,000
Queensland	122,000	131,000	286,000	4,000	527,000
New South Wales	138,000	117,000	107,000	19,000	180,000
Victoria	1,512,000	1,254,000	716,000	579,000	1,256,000
Tasmania	70,000	70,000	173,000	103,000	125,000
New Zealand	1,635,000	1,060,000	883,000	1,172,000	1,197,000
Total Australasia	3,730,000	2,880,000	2,453,000	2,252,000	3,843,000
Grand Total	959,622,000	1,058,055,000	1,216,393,000	1,252,259,000	1,167,053,000

Visible supply of barley in the United States and Canada, first of each month, for ten years.[a]

Month.	1895–1896.	1896–1897.	1897–1898.	1898–1899.	1899–1900.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	166,000	805,000	1,574,000	587,000	1,059,000
August	48,000	771,000	1,051,000	584,000	694,000
September	121,000	790,000	1,578,000	548,000	1,055,000
October	1,956,000	2,292,000	2,630,000	2,125,000	1,739,000
November	3,645,000	6,032,000	4,267,000	3,777,000	3,925,000
December	5,674,000	5,500,000	6,318,000	4,406,000	4,695,000
January	4,017,000	4,501,000	5,115,000	4,372,000	3,122,000
February	2,970,000	4,183,000	3,455,000	4,017,000	2,303,000
March	2,081,000	4,124,000	2,571,000	3,067,000	2,138,000
April	1,298,000	3,514,000	1,492,000	2,626,000	1,712,000
May	1,253,000	2,816,000	1,159,000	1,913,000	1,720,000
June	957,000	1,819,000	815,000	1,555,000	1,267,000

Month.	1900–1901.	1901–1902.	1902–1903.	1903–1904.	1904–1905.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	1,038,000	528,000	847,000	602,000	2,046,000
August	702,000	335,000	217,000	471,000	1,656,000
September	1,158,000	956,000	419,000	1,024,000	1,694,000
October	2,779,000	3,610,000	2,460,000	5,047,000	6,551,000
November	5,396,000	4,813,000	5,064,000	7,313,000	9,329,000
December	6,053,000	5,416,000	5,680,000	7,975,000	9,620,000
January	5,395,000	4,580,000	4,389,000	6,907,000	10,403,000
February	4,331,000	5,244,000	3,843,000	6,338,000	8,801,000
March	3,903,000	5,065,000	3,107,000	5,441,000	6,952,000
April	2,879,000	4,075,000	2,426,000	4,975,000	4,674,000
May	1,761,000	2,146,000	1,493,000	3,969,000	....
June	1,351,000	1,836,000	1,133,000	3,105,000	....

[a] These figures represent stocks available at 62 of the principal points of accumulation east of the Rocky Mountains, stocks in Manitoba elevators, and stocks afloat on lakes and canals as reported by Bradstreet's.

Condition of the barley crop of the United States, monthly, 1889–1904.

Year.	June.	July.	August.	September.	Year.	June.	July.	August.	September.
1889	95.6	91.9	90.6	88.9	1897	87.4	88.5	87.5	86.4
1890	86.4	88.3	82.8	78.6	1898	78.8	85.7	79.3	79.2
1891	90.3	90.9	93.8	94.3	1899	91.4	92.0	93.6	86.7
1892	92.1	92.0	91.1	87.4	1900	86.2	76.3	71.6	70.7
1893	88.3	88.8	84.6	83.8	1901	98.8	91.3	86.9	85.8
1894	82.2	76.8	69.8	71.5	1902	93.6	93.7	90.2	89.7
1895	90.3	91.9	87.2	87.6	1903	91.5	86.8	83.4	82.1
1896	98.0	88.1	82.9	83.1	1904	90.5	88.5	88.1	84.7

Acreage, production, value, prices, exports, etc., of barley of the United States, 1866–1904.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1.	Farm value, Dec. 1.	Chicago cash price per bushel, No. 2. December. Low.	December. High.	May of following year. Low.	May of following year. High.	Domestic exports, fiscal years beginning July 1.	Imports, fiscal years beginning July 1.
	Acres.	*Bush.*	*Bushels.*	*Cts.*	*Dollars.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Bushels.*	*Bushels.*
1866	492,532	22.9	11,283,807	70.2	7,916,342	59	70	85	100	....	3,247,250
1867	1,131,217	22.7	25,727,000	70.1	18,027,746	150	180	227	250	9,810	3,783,966
1868	937,498	24.4	22,896,100	109.0	24,948,127	140	170	149	175	59,077	5,069,880
1869	1,025,795	27.9	28,652,200	70.8	20,298,164	74	85	50	62	255,490	6,727,597
1870	1,108,924	23.7	26,295,400	79.1	20,792,213	68	80	72	95	340,093	4,866,700
1871	1,113,735	24.0	26,718,500	75.8	20,264,015	55½	64	55	71	86,891	5,565,591
1872	1,397,082	19.2	26,846,400	68.6	18,415,839	60	70	71	85	482,410	4,244,751
1873	1,387,106	23.1	32,044,491	86.7	27,794,229	132	158	130	155	320,399	4,891,189
1874	1,580,626	20.6	32,552,500	86.0	27,997,824	120	129½	115	137	91,118	6,255,063
1875	1,789,902	20.6	36,908,600	74.1	27,367,522	81	88	62½	72½	317,781	10,285,957
1876	1,766,511	21.9	38,710,500	63.0	24,402,691	63¾	68½	80	85	1,186,129	6,702,965
1877	1,614,654	21.3	34,441,400	62.8	21,629,130	56¼	64	46½	52½	3,921,501	6,764,228
1878	1,790,400	23.6	42,245,630	57.9	24,454,301	91	100	64	73	715,536	5,720,979
1879	1,680,700	24.0	40,283,100	58.9	23,714,444	86	92	75	80	1,128,923	7,135,258
1880	1,843,329	24.5	45,165,346	66.6	30,090,742	100	120	95	105	885,246	9,528,616
1881	1,967,510	20.9	41,161,330	82.3	33,862,513	101	107	100	100	205,930	12,182,722
1882	2,272,103	21.5	48,953,926	62.9	30,768,015	79	82	80	80	433,005	10,050,687
1883	2,379,009	21.1	50,136,097	58.7	29,420,423	62	67	65	74	724,955	8,596,122
1884	2,608,818	23.5	61,203,000	48.7	29,779,170	53	58	65	65	629,130	9,986,507
1885	2,729,359	21.4	58,360,000	56.3	32,867,696	62	65	58	60	252,183	10,197,115
1886	2,652,957	22.4	59,428,000	53.6	31,840,510	51	54	57	57	1,305,300	10,355,594
1887	2,901,953	19.6	56,812,000	51.9	29,464,390	80	80	69	77	550,884	10,831,461
1888	2,996,382	21.3	63,884,000	59.0	37,672,032	......	......	......	......	1,440,321	11,368,414
1889	3,220,834	24.3	78,332,976	41.6	32,614,271	58	58	......	......	1,408,311	11,332,545
1890	3,135,302	21.4	67,168,344	62.7	42,140,502	......	......	......	......	973,062	5,078,733
1891	3,352,579	25.9	86,839,153	52.4	45,470,342	......	......	......	......	2,800,075	3,146,328
1892	3,400,361	23.6	80,096,762	47.5	38,026,062	65	67	65	65	3,035,267	1,970,129
1893	3,220,371	21.7	69,869,495	41.1	28,729,386	52	54	55	60	5,219,405	791,061
1894	3,170,602	19.4	61,400,465	44.2	27,134,127	53½	55½	51	52	1,563,754	2,116,816
1895	3,299,973	26.4	87,072,744	33.7	29,312,413	33	40	25	36	7,680,331	837,384
1896	2,950,539	23.6	69,695,223	32.3	22,491,241	a 22	37	a 24½	35	20,030,301	1,271,787
1897	2,719,116	24.5	66,685,127	37.7	25,142,139	a 25½	42	a 36	53	11,237,077	124,804
1898	2,583,125	21.6	55,792,257	41.3	23,064,359	a 40	50½	a 36	42	2,267,403	110,475
1899	2,878,229	25.5	73,381,563	40.3	29,594,254	a 35	45	a 36	44	23,661,662	189,757
1900	2,894,282	20.4	58,925,833	40.8	24,075,271	a 37	61	a 37	57	6,293,207	171,004
1901	4,295,744	25.6	109,932,924	45.2	49,705,163	a 56	63	a 64	72	8,714,268	57,406
1902	4,661,063	29.0	134,954,023	45.9	61,898,634	a 36	70	a 55	62	8,429,141	56,462
1903	4,993,137	26.4	131,861,391	45.6	60,166,313	a 42	62½	38	59	10,881,627	90,708
1904	5,145,878	27.2	139,748,958	42.0	58,651,807	38	52	......	......	....	....

a Chicago prices from 1895 are for No. 3 grade.

The preceding table shows that the greatest area in barley, 5,145,878 acres, was reported in 1904; the greatest production, 139,748,958 bushels, in the same year; the greatest farm value on December 1, $61,898,634, in 1902; the greatest average yield per acre, 29 bushels in 1902; the greatest average farm price per bushel, $1.09, in 1868. For the five years, 1900–1904, the average area was 4,398,021 acres; the average production, 115,084,626 bushels; the average farm value on December 1, $50,899,438; the average yield per acre, 26.2 bushels; the average farm price per bushel on December 1, 44.2 cents.

Acreage, production, and value of barley in the United States in 1904, by States.

States and Territories.	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Average value per acre, Dec. 1.	Farm value, Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*	*Dollars.*
Maine	8,316	32.7	271,933	71	23.22	193,072
New Hampshire	1,585	20.7	32,810	75	15.53	24,608
Vermont	13,203	33.1	437,019	66	21.85	288,433
New York	97,558	26.8	2,614,554	57	15.28	1,490,296
Pennsylvania	9,054	22.6	204,620	56	12.66	114,587
Maryland	1,451	21.8	31,632	64	13.95	20,244
Virginia	2,575	24.7	63,602	61	15.07	38,797
Texas	5,208	31.0	161,448	73	22.63	117,857
Tennessee	1,235	22.0	27,170	64	14.08	17,389
Kentucky	841	20.6	17,325	65	13.39	11,261

Acreage, production, and value of barley in the United States in 1904, by States—Cont'd.

States and Territories.	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Average value per acre, Dec. 1.	Farm value, Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*	*Dollars.*
Ohio	28,599	27.5	786,472	52	14.30	408,965
Michigan	36,020	24.1	868,082	55	13.25	477,445
Indiana	10,139	29.2	296,059	48	14.02	142,108
Illinois	23,621	27.1	640,129	43	11.65	275,255
Wisconsin	498,043	30.0	14,941,290	43	12.90	6,424,755
Minnesota	1,131,093	28.4	32,123,041	32	9.09	10,279,373
Iowa	487,516	27.8	13,552,945	36	10.01	4,879,060
Missouri	1,929	20.3	39,159	62	12.59	24,279
Kansas	149,930	21.6	3,238,488	37	7.99	1,198,241
Nebraska	68,555	27.4	1,878,407	31	8.49	582,306
South Dakota	349,558	28.0	9,787,624	32	8.96	3,132,040
North Dakota	623,419	28.1	17,518,074	28	7.87	4,905,061
Montana	17,502	29.9	523,310	62	18.54	324,452
Wyoming	1,225	30.1	36,872	57	17.16	21,017
Colorado	19,295	37.1	715,844	57	21.15	408,031
New Mexico	694	23.6	16,378	90	21.24	14,740
Arizona	14,893	33.6	500,405	93	31.25	465,377
Utah	8,297	38.3	317,775	57	21.83	181,132
Nevada	7,023	35.9	252,126	72	25.85	181,531
Idaho	45,650	37.4	1,707,310	63	23.56	1,075,605
Washington	167,362	34.8	5,824,198	49	17.05	2,853,857
Oregon	61,084	28.7	1,753,111	59	16.93	1,034,335
California	1,237,533	22.7	28,091,999	60	13.62	16,855,199
Oklahoma	15,872	30.1	477,747	40	12.04	191,099
United States	5,145,878	27.2	139,748,958	42.0	11.40	58,651,807

Average yield per acre of barley in the United States, 1895–1904, by States.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	32.4	30.6	25.0	27.0	29.0	27.4	27.5	29.4	29.9	32.7
New Hampshire	25.6	29.3	22.5	23.5	25.0	22.7	21.5	21.2	19.8	20.7
Vermont	33.2	33.0	28.5	30.0	31.0	29.1	29.6	29.7	29.2	33.1
Massachusetts	22.5	30.0	34.5	24.5	30.0	25.8	......	......	......	......
Rhode Island	23.5	29.0	28.0	28.0	29.0	28.0	......	......	......	......
New York	22.9	23.2	25.0	25.2	24.0	22.0	14.0	28.5	26.6	26.8
Pennsylvania	20.2	17.2	24.5	19.4	21.0	19.0	17.2	21.0	21.3	22.6
Maryland	......	......	......	......	......	......	18.0	27.0	25.9	21.8
Virginia	......	......	......	......	......	......	24.9	18.3	24.4	24.7
Texas	21.6	12.0	25.0	20.0	18.0	24.6	13.5	21.3	24.4	31.0
Tennessee	23.1	14.0	18.0	18.0	11.0	14.7	16.8	16.0	20.6	22.0
Kentucky	33.3	14.8	20.0	16.0	21.0	28.6	19.4	25.9	21.4	20.6
Ohio	28.2	20.2	28.5	28.7	28.0	27.0	24.9	32.3	23.3	27.5
Michigan	18.1	22.3	21.5	25.2	24.0	23.9	22.8	28.6	25.2	24.1
Indiana	15.0	20.3	19.0	23.4	25.0	24.6	25.4	28.0	22.8	29.2
Illinois	20.0	23.7	25.0	27.3	29.0	25.6	24.5	28.6	28.2	27.1
Wisconsin	29.3	27.4	28.0	29.1	30.0	25.5	27.2	33.8	27.7	30.0
Minnesota	36.0	27.2	25.5	28.4	25.0	22.4	25.8	28.6	25.3	28.4
Iowa	28.0	26.3	24.0	26.0	26.0	26.4	23.6	26.3	23.4	27.8
Missouri	15.3	17.5	19.0	20.0	18.0	20.8	16.5	25.0	18.3	20.3
Kansas	14.4	4.6	17.5	28.0	17.0	21.5	15.9	16.0	31.9	21.6
Nebraska	28.4	19.9	22.0	27.1	26.0	17.6	16.0	31.1	26.6	27.4
South Dakota	19.5	28.5	20.0	23.0	23.0	14.3	22.4	29.2	31.4	28.0
North Dakota	30.4	16.1	22.5	26.4	24.0	8.2	28.2	31.6	21.6	28.1
Montana	25.0	25.0	38.0	36.0	35.0	38.8	39.0	37.0	40.2	29.9
Wyoming	......	......	......	......	......	......	32.5	24.4	21.3	30.1
Colorado	31.3	20.0	28.0	30.5	28.0	24.8	28.7	26.3	38.3	37.1
New Mexico	28.0	19.0	32.5	33.8	32.0	29.0	31.7	16.1	23.1	23.6
Arizona	......	......	......	......	......	......	28.7	25.2	32.8	33.6
Utah	30.0	27.1	31.0	37.0	33.0	36.5	35.0	32.1	37.5	38.3
Nevada	......	......	......	......	......	......	33.0	34.3	34.6	35.9
Idaho	24.5	15.3	35.0	35.0	35.0	32.8	40.2	46.3	34.4	37.4
Washington	37.3	26.0	45.0	39.8	35.0	33.4	43.5	43.7	37.9	34.8
Oregon	22.1	21.8	32.5	29.1	28.0	28.9	30.6	31.9	33.2	28.7
California	20.3	21.6	23.0	10.5	26.0	16.7	26.0	26.0	25.7	22.7
Oklahoma	......	......	......	......	......	......	22.0	36.0	26.9	30.1
General average	26.4	23.6	24.5	21.6	25.5	20.4	25.6	29.0	26.4	27.2

Average yield of barley in certain countries, in bushels per acre, 1894–1903.

Year.	United States.	Russia.	Germany.	Austria.	Hungary.	France.	United Kingdom.
	(*a*)	(*b*)	(*b*)	(*b*)	(*b*)	(*a*)	(*a*)
1894	19.4	15.3	33.0	22.3	22.7	22.0	35.9
1895	26.4	13.7	31.2	20.9	21.4	21.9	33.1
1896	23.6	12.8	30.7	19.3	24.0	21.8	35.2
1897	24.5	11.8	29.0	17.6	17.6	19.4	33.9
1898	21.6	14.9	32.2	22.0	23.6	23.3	37.4
1899	25.5	11.1	33.8	24.9	24.0	22.7	35.7
1900	20.4	11.4	33.4	20.2	20.9	21.8	32.7
1901	25.6	11.2	33.3	22.5	20.0	21.1	32.7
1902	29.0	15.6	35.1	24.5	24.7	24.5	36.9
1903	26.4	15.5	36.2	24.7	24.9	25.2	33.4
Average	24.2	13.3	32.8	21.9	22.4	22.4	34.7

a Winchester bushels. *b* Bushels of 48 pounds.

Average value per acre of barley in the United States, based upon farm value December 1, 1895–1904, by States.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Maine	$16.85	$13.16	$13.75	$15.12	$17.11	$16.99	$18.43	$19.99	$21.23	$23.22
New Hampshire	14.34	15.53	13.50	13.63	16.25	15.21	17.20	15.90	16.63	15.53
Vermont	15.60	13.53	13.11	14.10	16.12	15.13	19.54	18.12	17.52	21.85
Massachusetts	14.63	17.40	22.77	16.17	20.40	17.80	......	......	......	......
Rhode Island	17.63	17.40	15.12	17.08	20.30	21.56	......	......	......	......
New York	18.55	9.05	10.50	12.10	12.00	11.22	7.84	15.68	14.63	15.28
Pennsylvania	8.28	6.88	9.55	8.54	10.29	9.50	10.15	11.34	11.93	12.66
Maryland	......	......	......	......	......	......	9.36	13.23	12.95	13.95
Virginia	......	......	......	......	......	......	11.70	9.88	13.91	15.07
Texas	11.66	6.00	10.75	10.00	11.88	17.71	11.88	15.34	17.08	22.63
Tennessee	11.55	6.30	10.62	10.08	7.04	9.11	11.76	9.76	13.39	14.08
Kentucky	12.65	5.92	8.00	6.40	9.03	15.73	13.77	14.50	13.48	13.39
Ohio	11.56	7.68	11.69	12.63	12.60	11.61	12.70	15.83	11.65	14.30
Michigan	7.78	9.37	8.60	11.09	11.52	11.23	12.31	14.87	13.10	13.25
Indiana	6.00	6.70	8.36	10.30	11.25	11.56	12.95	12.88	11.40	14.02
Illinois	9.00	7.35	9.50	10.65	13.63	12.03	12.99	12.58	12.41	11.65
Wisconsin	9.96	7.40	8.96	11.64	12.00	11.22	13.87	15.55	13.30	12.90
Minnesota	8.64	5.44	6.12	9.37	7.75	8.51	11.61	10.58	9.36	9.09
Iowa	6.44	5.52	5.76	8.84	8.06	9.77	11.09	9.47	8.42	10.01
Missouri	7.34	4.38	7.60	7.20	7.56	9.36	9.08	13.75	9.88	12.59
Kansas	3.31	1.01	4.38	7.56	4.59	7.10	7.15	6.08	10.85	7.99
Nebraska	6.82	3.78	5.28	6.78	7.80	5.81	6.56	10.26	8.78	8.49
South Dakota	3.71	5.42	4.40	6.21	6.67	4.43	9.41	11.10	10.36	8.96
North Dakota	6.08	3.38	6.07	7.66	7.92	2.87	11.28	11.38	7.78	7.87
Montana	14.75	13.75	19.00	20.52	17.85	18.62	22.23	18.87	23.32	18.54
Wyoming	......	......	......	......	......	......	21.12	18.30	15.34	17.16
Colorado	18.78	9.20	14.28	14.03	15.40	12.40	18.08	15.78	23.36	21.15
New Mexico	19.04	12.35	17.88	18.59	19.52	17.98	20.61	11.43	14.78	21.24
Arizona	......	......	......	......	......	......	19.52	22.93	23.62	31.25
Utah	11.70	11.38	13.95	17.39	17.16	20.07	18.55	18.94	22.13	21.83
Nevada	......	......	......	......	......	......	23.10	27.44	29.41	25.85
Idaho	10.29	3.37	14.70	16.80	16.10	16.40	21.31	24.54	17.89	23.56
Washington	14.17	10.40	19.35	17.91	15.40	13.03	17.83	20.10	18.95	17.05
Oregon	8.84	9.81	14.63	14.26	14.00	12.14	14.99	16.59	19.59	16.93
California	8.12	10.37	12.42	6.82	13.00	7.18	10.66	16.38	15.68	13.62
Oklahoma	......	......	......	......	......	......	10.78	15.12	11.84	12.04
General average	8.88	7.62	9.25	8.93	10.28	8.32	11.57	13.28	12.05	11.40

Average farm price of barley per bushel in the United States December 1, 1895–1904, by States.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	52	43	55	56	59	62	67	68	71	71
New Hampshire	56	53	60	58	65	67	80	75	84	75
Vermont	47	41	46	47	52	52	66	61	60	66
Massachusetts	65	58	66	66	68	69	......	......	......	......
Rhode Island	75	60	54	61	70	77	......	......	......	......
New York	81	39	42	48	50	51	56	55	55	57
Pennsylvania	41	40	39	44	49	50	59	54	56	56
Maryland	......	......	......	......	......	......	52	49	50	64
Virginia	......	......	......	......	......	......	47	54	57	61
Texas	54	50	43	50	66	72	88	72	70	73
Tennessee	50	45	59	56	64	62	70	61	65	64
Kentucky	38	40	40	40	43	55	71	56	68	65
Ohio	41	38	41	44	45	43	51	49	50	52
Michigan	43	42	40	44	48	47	54	52	52	55
Indiana	40	33	44	44	45	47	51	46	50	48
Illinois	45	31	38	39	47	47	53	44	44	43
Wisconsin	34	27	32	40	40	44	51	46	48	43
Minnesota	24	20	24	33	31	38	45	37	37	32
Iowa	23	21	24	34	31	37	47	36	36	36
Missouri	48	25	40	36	42	45	55	55	54	62
Kansas	23	22	25	27	27	33	45	38	34	37
Nebraska	24	19	24	25	30	33	41	33	33	31
South Dakota	19	19	22	27	29	31	42	38	33	32
North Dakota	20	21	27	29	33	35	40	36	36	28
Montana	59	55	50	57	51	48	52	51	58	62
Wyoming	......	......	......	......	......	......	65	75	72	57
Colorado	60	46	51	46	55	50	63	60	61	57
New Mexico	68	65	55	55	61	62	65	71	64	90
Arizona	......	......	......	......	......	......	68	91	72	93
Utah	39	42	45	47	52	55	53	59	59	57
Nevada	......	......	......	......	......	......	70	80	85	72
Idaho	42	22	42	48	46	50	53	53	52	63
Washington	38	40	43	45	44	39	41	46	50	49
Oregon	40	45	45	49	50	42	49	52	59	59
California	40	48	54	65	50	43	41	63	61	60
Oklahoma	......	......	......	......	......	......	49	42	44	40
General average	33.7	32.3	37.7	41.3	40.3	40.8	45.2	45.9	45.6	42.0

Transportation rates, average for barley in sacks, in cents per 100 pounds, St. Louis to New Orleans, by river.

1884	14.00	1891	16.28	1898	10.00
1885	15.00	1892	16.87	1899	10.00
1886	16.00	1893	17.54	1900	10.00
1887	18.25	1894	17.14	1901	10.00
1888	15.00	1895	13.00	1902	10.00
1889	17.93	1896	14.54	1903	10.00
1890	15.66	1897	10.83	1904	(a)

a No shipment.

Wholesale prices of barley per bushel in leading cities of the United States, 1900–1904.

Date.	New York.		Cincinnati.		Chicago.		San Francisco.	
	Western.		Extra No. 3 spring.		No. 3.		No. 1, brewing (per cwt.).	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1900.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*		
January	49	50	44¾	49	34	48	$0.72½	$0.75
February	50	51	47	49	34	46	.72½	.75
March	52	50	47	49	36	44	.72½	.73¾
April	52	52½	47	49	35	45	.72½	.72½
May	52	52	47	49	36	44	.67½	.72½
June	51	55	....	....	36	48	.67½	.70
July	54	54	....	....	36	48	.70	.71¼
August	52	57	....	....	33	50	.72½	.72½
September	54	58	46	55	38	57	.72½	.72½
October	60	62	56	64	36	59	.71¼	.72½
November	62	65	56	66	36	62	.72½	.75
December	64	66	58	66	37	61	.72½	.75

Wholesale prices of barley per bushel in leading cities of the United States, 1900–1904—Cont'd.

Date.	New York.		Cincinnati.		Chicago.		San Francisco.	
	Western.		Extra No. 3 spring.		No. 3.		No. 1 brewing (per cwt.)	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1901.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*		
January	65	68	62	70	36	63	$0.75	$0.80
February	65	70	62	70	37	61	.73¾	.81¼
March	59	65	62	66	37	59	.75	.82½
April	61	63	60	66	38	58	.78¾	.85
May	63	63	60	64	37	57	.77½	.81¼
June	....	....	59	62	40	54	.75	.80
July	57	60	....	....	40	65	.77½	.82½
August	64	67	58	60	48	65	.80	.83¾
September	65	67	65	67	50	62	.80	.82½
October	60	68	62	67	51	60	.77½	.82½
November	62	69	62	66	51	63	.76¾	.82½
December	70	72	68	69	56	63	.78¾	.85
1902.								
January	72	75	67	70	57	65½	.80	.95
February	73	73	67	69	58	64	.90	1.02½
March	73	74	67	70	58	67	.92½	1.02½
April	73	74	68	74	61	70	.93¾	1.02½
May	74	75	67	69	64	72	.95	1.07½
June	....	....	67	69	64	71	.92½	1.01¼
July	....	....	....	....	48	73	.92½	1.00
August	71	72	....	....	41	65	.93¾	1.01¼
September	65	71	55	65	38	63	.96¼	1.15
October	64	66	55	65	35	60	1.12½	1.25
November	66	66	55	65	35	58	1.18¾	1.30
December	68	68	55	65	36	70	1.22½	1.32½
1903.							No. 1 feed.	
January	....	....	55	65	45	58	1.15	1.21¼
February	....	....	56	65	47	56	1.15	1.22½
March	....	....	56	65	46	55	1.11¼	1.20
April	....	....	55	62	46	55	1.05	1.16¼
May	....	....	55	62	48	56	1.05	1.12¼
June	....	....	55	62	49	54	.90	1.12½
July	....	....	....	....	47	53	.97½	1.10
August	....	....	....	....	47	57	1.02½	1.13¾
September	....	....	62	71	51	63	1.08¾	1.16¼
October	....	....	61	69	46	62	1.08¾	1.16¼
November	....	....	62	69	43	61½	1.11¼	1.15
December	....	....	60	69	42	61½	1.07½	1.15
1904.								
January	....	....	60	69	37	61	1.10	1.13¾
February	....	....	62	69	40	61	1.07½	1.15
March	....	....	62	69	40	54	1.06¼	1.15
April	....	....	62	69	38	60	1.07½	1.15
May	....	....	62	69	38	59	1.03¾	1.10
June	....	....	62	69	35	59	.95	1.06¼
July	....	....	....	....	36	55	.95	1.03¾
August	....	....	....	....	38	55	1.03¾	1.10
September	....	....	....	....	38	55	1.05	1.12½
October	....	....	55	62	37	54	1.07½	1.12½
November	....	....	55	60	38	53	1.07½	1.13¾
December	....	....	55	60	38	52	1.10	1.15

RYE.

Rye crop of countries named, 1900–1904.

Countries.	1900.	1901.	1902.	1903.	1904.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States	23,996,000	30,345,000	33,631,000	29,363,000	27,242,000
Ontario	2,432,000	2,625,000	3,620,000	3,064,000	2,065,000
Manitoba	27,000	64,000	51,000	51,000	130,000
Rest of Canada	286,000	800,000	800,000	800,000	800,000
Total Canada	2,745,000	3,489,000	4,471,000	3,915,000	2,995,000
Total North America	26,741,000	33,834,000	38,102,000	33,278,000	30,237,000

Rye crop of countries named, 1900-1904—Continued.

Countries.	1900.	1901.	1902.	1903.	1904.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Great Britain	....	....	....	....	....
Ireland	....	....	....	....	....
Total United Kingdom	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000
Sweden	23,708,000	21,771,000	22,293,000	24,261,000	20,900,000
Denmark	19,958,000	16,605,000	18,779,000	19,305,000	18,000,000
Netherlands	13,644,000	14,180,000	13,971,000	13,973,000	14,000,000
Belgium	19,854,000	25,045,000	22,374,000	21,756,000	22,000,000
France	59,277,000	58,198,000	47,051,000	57,951,000	53,343,000
Spain	21,424,000	28,370,000	26,187,000	22,511,000	19,000,000
Italy	4,000,000	4,000,000	3,200,000	4,000,000	3,200,000
Germany	336,624,000	321,350,000	373,768,000	389,923,000	396,075,000
Austria	54,792,000	75,514,000	82,482,000	81,130,000	91,728,000
Hungary	40,205,000	40,883,000	49,458,000	47,355,000	43,880,000
Croatia-Slavonia	2,286,000	2,774,000	3,049,000	3,386,000	2,401,000
Total Austria-Hungary	97,283,000	119,171,000	134,989,000	131,871,000	138,009,000
Roumania	5,990,000	9,573,000	6,958,000	7,145,000	2,201,000
Bulgaria	7,000,000	7,000,000	8,000,000	11,000,000	13,000,000
Russia proper	828,816,000	680,205,000	810,537,000	803,296,000	893,064,000
Poland	67,621,000	50,781,000	75,257,000	69,100,000	76,606,000
North Caucasus	7,500,000	7,937,000	8,654,000	7,498,000	8,179,000
Total Russia in Europe	903,937,000	738,923,000	894,448,000	879,894,000	977,849,000
Total Europe	1,514,699,000	1,366,186,000	1,574,018,000	1,585,590,000	1,679,637,000
Siberia	15,853,000	15,620,000	23,080,000	30,982,000	29,445,000
Central Asia	341,000	382,000	1,489,000	1,066,000	1,087,000
Total Russia in Asia	16,194,000	16,002,000	24,569,000	32,048,000	30,532,000
Japan [a]	....	....	....	....	....
Grand total	1,557,634,000	1,416,022,000	1,636,689,000	1,650,916,000	1,740,406,000

[a] No rye is raised in Japan. In the Japanese official crop reports occurs the caption "Seigle," the French word for rye, and in previous issues of the Yearbook of this Department the figures under that caption have been taken as indicating the rye crop of Japan. Careful investigation has revealed that the word seigle in the Japanese reports was intended to indicate a variety of barley. The figures appearing in former issues of the Yearbook as the rye crop of Japan have therefore in this issue been omitted and have been embodied in another table with the barley crop of Japan.

Visible supply of rye in the United States and Canada, first of each month, for ten years. [a]

Month.	1895-1896.	1896-1897.	1897-1898.	1898-1899.	1899-1900.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	158,000	1,575,000	2,464,000	988,000	904,000
August	215,000	1,630,000	1,946,000	365,000	638,000
September	511,000	2,328,000	2,499,000	721,000	647,000
October	700,000	2,040,000	3,064,000	894,000	962,000
November	1,250,000	2,596,000	3,882,000	1,260,000	1,906,000
December	1,702,000	2,695,000	3,932,000	1,212,000	1,892,000
January	1,739,000	3,276,000	4,436,000	1,573,000	1,806,000
February	1,763,000	4,266,000	4,291,000	1,576,000	1,734,000
March	1,710,000	4,104,000	4,099,000	1,724,000	1,951,000
April	1,631,000	4,128,000	3,682,000	1,658,000	1,566,000
May	1,481,000	3,607,000	3,039,000	1,335,000	1,441,000
June	1,467,000	2,798,000	1,526,000	975,000	1,206,000

[a] These figures represent stocks available at 62 of the principal points of accumulation east of the Rocky Mountains, stocks in Manitoba elevators, and stocks afloat on lakes and canals, as reported by Bradstreet's.

Visible supply of rye in the United States and Canada, first of each month, for ten years—Continued.

Month.	1900-1901.	1901-1902.	1902-1903.	1903-1904.	1904-1905.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	806,000	747,000	442,000	926,000	938,000
August	725,000	753,000	328,000	867,000	968,000
September	1,056,000	1,864,000	903,000	866,000	1,233,000
October	1,216,000	2,440,000	1,362,000	1,259,000	1,686,000
November	1,513,000	2,863,000	1,828,000	1,509,000	2,055,000
December	1,754,000	3,463,000	2,159,000	1,744,000	2,525,000
January	1,651,000	3,257,000	2,454,000	1,833,000	2,504,000
February	1,530,000	3,270,000	2,354,000	1,746,000	2,259,000
March	1,532,000	2,972,000	2,273,000	1,717,000	1,961,000
April	1,333,000	2,639,000	1,688,000	1,483,000	1,554,000
May	1,112,000	1,910,000	1,879,000	1,554,000	....
June	938,000	950,000	2,027,000	1,186,000	....

Condition of the rye crop of the United States, monthly, 1887-1904.

Year.	Apr.	May.	June.	July.	Aug.	When harvested.	Year.	Apr.	May.	June.	July.	Aug.	When harvested.
1887	92.0	90.8	88.9	88.0	84.6	82.2	1896	82.9	87.7	85.2	83.8	88.0	82.0
1888	93.5	92.9	93.9	95.1	91.4	92.8	1897	88.9	88.0	89.9	95.0	89.8	90.1
1889	93.9	96.5	95.2	96.7	95.4	91.6	1898	92.1	94.5	97.1	93.8	93.7	89.4
1890	92.8	93.5	92.3	92.0	86.8	85.4	1899	84.9	85.2	84.5	83.3	89.0	82.0
1891	95.4	97.2	95.4	93.9	89.6	95.1	1900	84.8	88.5	87.6	89.6	76.0	84.2
1892	87.0	88.9	91.0	92.9	89.8	88.5	1901	93.1	94.6	93.9	93.5	83.6	84.0
1893	85.7	82.7	84.6	83.8	78.5	82.0	1902	85.4	83.4	88.1	90.3	90.5	90.2
1894	94.4	90.7	93.2	93.9	79.8	86.9	1903	97.9	93.3	90.6	89.2	87.2	84.1
1895	87.0	88.7	85.7	82.2	84.0	83.7	1904	82.3	81.2	86.3	[a] 90.8	91.8	86.9

[a] Spring rye.

Acreage, production, value, prices, and exports of rye of the United States, 1866-1904.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1.	Farm value, Dec. 1.	Chicago cash price per bushel, No. 2.				Domestic exports, including rye flour, fiscal years beginning July 1.
						December.		May of following year.		
						Low.	High.	Low.	High.	
	Acres.	*Bush.*	*Bushels.*	*Cents.*	*Dollars.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Bushels.*
1866	1,548,033	13.5	20,864,944	82.2	17,149,716	......	......	142	150	234,971
1867	1,689,175	13.7	23,184,000	100.4	23,280,584	132	157	173	185	564,901
1868	1,651,321	13.6	22,504,800	94.9	21,349,190	106½	118	100	115½	92,869
1869	1,657,584	13.6	22,527,900	77.0	17,341,861	66	77½	78	83½	199,450
1870	1,176,137	13.2	15,473,600	73.2	11,326,967	67	74	81	91	87,174
1871	1,069,531	14.4	15,365,500	71.1	10,927,623	62	63¾	75	93	832,689
1872	1,048,654	14.2	14,888,600	67.6	10,071,061	57½	70	68½	70	611,749
1873	1,150,355	13.2	15,142,000	70.3	10,638,258	70	81	91	102	1,923,404
1874	1,116,716	13.4	14,990,900	77.4	11,610,339	93	99½	103	107½	267,058
1875	1,359,788	13.0	17,722,100	67.1	11,894,223	67	68¾	61½	70½	589,159
1876	1,468,374	13.9	20,374,800	61.4	12,504,970	65½	73	70	92½	2,234,856
1877	1,412,902	15.0	21,170,100	57.6	12,201,759	55½	56½	54	60	4,249,684
1878	1,622,700	15.9	25,842,790	52.5	13,566,002	44	44½	47	52	4,877,821
1879	1,625,450	14.5	23,639,460	65.6	15,507,431	73½	81	73½	85	2,943,894
1880	1,767,619	13.9	24,540,829	75.6	18,564,560	82	91½	115	118	1,955,155
1881	1,789,100	11.6	20,704,950	93.3	19,327,415	96½	98	77	83	1,003,609
1882	2,227,894	13.4	29,960,037	61.5	18,439,194	57	58½	62	67	2,206,212
1883	2,314,754	12.1	28,058,582	58.1	16,300,503	56½	60	60½	62½	6,247,590
1884	2,343,963	12.2	28,640,000	51.9	14,857,040	51	52	68	73	2,974,390
1885	2,129,301	10.2	21,756,000	57.9	12,594,820	58½	61	58	61	216,699
1886	2,129,918	11.5	24,489,000	53.8	13,181,330	53	54½	54½	56½	377,302
1887	2,053,447	10.1	20,693,000	54.5	11,283,140	55½	61½	63	68	94,827
1888	2,364,805	12.0	28,415,000	58.8	16,721,869	50	52	39	41½	309,266
1889	2,171,493	13.1	28,420,299	42.3	12,009,752	44	45½	49½	54	2,280,975
1890	2,141,853	12.0	25,807,472	62.9	16,229,992	64½	68½	83	92	358,263
1891	2,176,466	14.6	31,751,868	77.4	24,589,217	86	92	70¼	79	12,068,628
1892	2,163,657	12.9	27,978,824	54.2	15,160,056	46	51	50½	62	1,493,924
1893	2,038,485	13.0	26,555,446	51.3	13,612,222	45	47½	44½	48	249,152
1894	1,944,780	13.7	26,727,615	50.1	13,395,476	47½	49	62½	67	32,045
1895	1,890,345	14.4	27,210,070	44.0	11,964,826	32	35¾	33	36½	1,011,128

Acreage, production, value, prices, and exports of rye of the United States, 1866–1904—Continued.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1.	Farm value, Dec. 1.	Chicago cash price per bushel, No. 2. December. Low.	Chicago cash price per bushel, No. 2. December. High.	Chicago cash price per bushel, No. 2. May of following year. Low.	Chicago cash price per bushel, No. 2. May of following year. High.	Domestic exports, including rye flour, fiscal years beginning July 1.
	Acres.	*Bush.*	*Bushels.*	*Cents.*	*Dollars.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Bushels.*
1896	1,831,201	13.3	24,369,047	40.9	9,960,769	37	$42\frac{1}{2}$	$32\frac{3}{4}$	$35\frac{1}{2}$	8,575,667
1897	1,703,561	16.1	27,363,324	44.7	12,239,647	$45\frac{3}{4}$	47	48	75	15,562,035
1898	1,643,207	15.6	25,657,522	46.3	11,875,350	$52\frac{1}{2}$	$55\frac{1}{2}$	$56\frac{1}{2}$	62	10,169,822
1899	1,659,308	14.4	23,961,741	51.0	12,214,118	49	52	53	$56\frac{1}{4}$	2,382,012
1900	1,591,362	15.1	23,995,927	51.2	12,295,417	$45\frac{3}{4}$	$49\frac{3}{4}$	$51\frac{1}{2}$	54	2,345,512
1901	1,987,505	15.3	30,344,830	55.7	16,909,742	59	$65\frac{3}{4}$	$54\frac{1}{2}$	58	2,712,077
1902	1,978,548	17.0	33,630,592	50.8	17,080,793	48	$49\frac{3}{4}$	48	$50\frac{1}{2}$	5,445,273
1903	1,906,894	15.4	29,363,416	54.5	15,993,871	$50\frac{1}{2}$	$52\frac{1}{2}$	$69\frac{3}{4}$	78	784,068
1904	1,792,673	15.2	27,241,515	68.8	18,748,323	73	75	......	......	....

The preceding table shows that the greatest area in rye, 2,364,805 acres, was reported in 1888; the greatest production, 33,630,592 bushels, in 1902; the greatest farm value on December 1, $24,589,217, in 1891; the greatest average yield per acre, 17 bushels, in 1902; the greatest average farm price per bushel on December 1, $1.004, in 1867. For the five years 1900–1904 the average area is 1,851,396 acres; the average production, 28,915,256 bushels; the average farm value on December 1, $16,205,629; the average yield per acre, 15.6 bushels; the average farm price per bushel on December 1, 56 cents.

Acreage, production, and value of rye in the United States in 1904, by States.

States and Territories.	Acreage.	Average yield per acre.	Production.	Average farm price Dec. 1.	Average value per acre Dec. 1.	Farm value, Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*	*Dollars.*
Vermont	1,905	16.9	32,194	74	12.51	23,824
Massachusetts	4,018	17.0	68,306	82	13.94	56,011
Connecticut	10,464	16.9	176,842	79	13.35	139,705
New York	147,146	14.8	2,177,761	73	10.80	1,589,766
New Jersey	69,967	17.5	1,224,422	70	12.25	857,095
Pennsylvania	346,265	15.5	5,367,108	71	11 01	3,810,647
Delaware	1,069	11.8	12,614	73	8.61	9,208
Maryland	20,525	14.8	303,770	76	11.25	230,865
Virginia	23,841	15.7	374,304	74	11.62	276,985
North Carolina	19,698	9.9	195,010	87	8.61	169,659
South Carolina	4,226	7.5	31,695	126	9.45	39,936
Georgia	13,640	8.3	113,212	102	8.47	115,476
Alabama	1,557	10.4	16,193	120	12.48	19,432
Texas	3,375	13.1	44,212	86	11.27	38,022
Arkansas	2,332	11.1	25,885	88	9.77	22,779
Tennessee	12,933	11.7	151,316	79	9.24	119,540
West Virginia	10,188	12.5	127,350	77	9.63	98,060
Kentucky	12,228	13.7	167,524	80	10.96	134,019
Ohio	13,748	16.1	221,343	74	11.91	163,794
Michigan	132,772	13.2	1,752,590	72	9.50	1,261,865
Indiana	32,780	14.6	478,588	69	10.07	330,226
Illinois	72,930	17.6	1,283,568	70	12.32	898,498
Wisconsin	302,794	16.2	4,905,263	69	11.18	3,384,631
Minnesota	93,162	17.7	1,648,967	64	11.33	1,055,339
Iowa	61,606	17.2	1,059,623	60	10.32	635,774
Missouri	19,642	14.4	282,845	64	9.22	181,021
Kansas	70,332	13.2	928,382	65	8.58	603,448
Nebraska	136,534	15.8	2,157,237	55	8.69	1,186,480
South Dakota	33,843	16.5	558,410	57	9.41	318,294
North Dakota	22,404	18.5	414,474	60	11.10	248,684
Montana	1,871	19.9	37,233	77	15.32	28,669
Wyoming	396	19.5	7,722	40	7.80	3,089
Colorado	2,786	19.1	53,213	65	12.41	34,588
Utah	3,701	16.0	59,216	67	10.72	39,675
Idaho	1,293	19.7	25,472	75	14.77	19,104
Washington	2,823	19.0	53,637	79	15.01	42,373
Oregon	11,135	14.4	160,344	89	12.82	142,706
California	67,402	7.6	512,255	78	5.93	399,559
Oklahoma	3,342	9.4	31,415	62	5.83	19,477
Total	1,792,673	15.2	27,241,515	68.8	10.46	18,748,323

Average yield per acre of rye in the United States, 1895–1904, by States.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	19.2	18.0	13.5	18.0	15.0	17.2	......	......	......	......
New Hampshire	16.0	19.6	18.0	17.5	15.0	17.1	......	......	......	......
Vermont	16.0	18.6	16.0	19.1	17.0	16.6	18.3	16.9	19.4	16.9
Massachusetts	19.9	22.0	19.5	16.7	16.0	16.9	15.9	15.2	13.7	17.0
Connecticut	16.9	15.4	19.0	18.0	18.0	17.0	18.0	17.4	17.0	16.9
New York	18.1	14.3	18.5	17.5	16.0	15.1	14.9	17.5	15.2	14.8
New Jersey	13.6	13.8	17.0	15.5	15.0	15.9	15.0	16.4	13.8	17.5
Pennsylvania	15.1	16.0	19.0	16.1	15.0	15.3	15.9	16.0	15.6	15.5
Delaware	......	......	......	......	......	......	15.3	13.5	14.8	11.8
Maryland	12.9	9.2	17.0	14.5	14.0	16.5	14.4	14.0	13.7	14.8
Virginia	11.0	10.0	11.0	11.2	9.0	10.5	11.1	9.6	12.2	15.7
North Carolina	7.7	7.5	8.8	9.1	7.0	8.9	8.5	8.2	8.8	9.9
South Carolina	9.3	4.8	6.6	8.5	5.0	7.5	7.7	7.6	7.6	7.5
Georgia	7.2	7.1	7.4	8.0	6.0	7.0	7.6	6.3	7.9	8.3
Alabama	10.2	8.0	9.6	11.1	8.0	7.8	8.0	10.0	10.6	10.4
Texas	5.5	7.0	12.0	12.0	10.0	16.5	11.1	9.9	14.2	13.1
Arkansas	10.0	10.0	11.0	11.4	11.0	11.5	8.7	12.3	9.7	11.1
Tennessee	7.2	9.0	10.0	10.5	9.0	11.0	11.3	11.0	13.4	11.7
West Virginia	16.1	10.6	11.5	11.2	10.0	10.5	12.0	8.1	11.5	12.5
Kentucky	13.2	11.0	13.0	13.0	10.0	13.1	14.0	13.4	11.6	13.7
Ohio	14.8	9.6	18.0	17.4	16.0	16.6	16.9	17.5	15.3	16.1
Michigan	13.6	9.2	15.0	15.3	14.0	14.6	14.0	17.9	15.5	13.2
Indiana	12.2	10.6	13.0	15.5	13.0	15.1	14.5	14.5	12.6	14.6
Illinois	15.2	15.3	15.5	14.8	15.0	17.2	17.0	19.1	16.5	17.6
Wisconsin	16.1	14.5	16.0	15.3	15.0	15.8	15.9	18.9	16.6	16.2
Minnesota	21.1	15.6	17.2	20.5	18.0	19.5	19.3	22.3	18.4	17.7
Iowa	20.6	17.5	16.0	19.0	18.0	18.0	18.4	17.4	16.9	17.2
Missouri	12.2	12.2	12.0	13.1	13.0	14.0	14.2	18.2	12.8	14.4
Kansas	5.9	7.0	14.0	15.6	11.0	15.2	14.3	12.0	16.2	13.2
Nebraska	9.3	16.9	17.0	18.8	16.0	14.2	15.0	20.3	14.2	15.8
South Dakota	8.4	11.6	16.5	16.6	15.0	10.6	14.4	18.8	20.2	16.5
North Dakota	21.3	12.0	14.5	15.0	15.0	5.2	13.8	20.2	15.7	18.5
Montana	......	......	......	......	......	......	26.7	25.0	24.6	19.9
Wyoming	......	......	......	......	......	......	24.0	18.0	18.0	19.5
Colorado	14.5	23.5	15.0	18.0	14.0	16.8	16.1	15.9	18.3	19.1
Utah	19.8	20.0	12.0	19.5	17.0	17.5	14.2	12.4	16.1	16.0
Idaho	......	......	......	......	......	......	15.0	20.2	18.5	19.7
Washington	26.7	15.0	19.5	18.0	16.0	16.3	17.5	17.8	21.0	19.0
Oregon	11.2	12.7	15.0	14.4	11.0	16.1	15.7	13.4	14.2	14.4
California	11.6	14.3	12.2	9.0	15.0	13.0	12.8	12.0	12.3	7.6
Oklahoma	......	......	......	......	......	......	14.8	16.0	17.9	9.4
General average	14.4	13.3	16.1	15.6	14.4	15.1	15.3	17.0	15.4	15.2

Average yield of rye in certain countries, in bushels per acre, 1894–1903.

Year.	United States.	Russia.	Germany.	Austria.	Hungary.	France.	Ireland.
	(a)	(b)	(b)	(b)	(b)	(a)	(b)
1894	13.7	12.7	22.0	17.2	19.5	19.5	25.4
1895	14.4	11.6	20.9	14.5	16.7	18.8	26.8
1896	13.3	10.9	22.7	16.3	18.2	18.7	25.4
1897	16.1	9.3	21.8	13.9	13.5	13.4	21.6
1898	15.6	10.5	24.2	17.7	16.9	18.3	25.8
1899	14.4	12.8	23.6	18.7	17.7	18.2	25.8
1900	15.1	12.5	22.9	13.0	15.1	16.9	25.6
1901	15.3	14.0	22.4	16.9	15.8	16.7	27.4
1902	17.0	12.5	24.5	18.2	19.1	14.3	28.0
1903	15.4	12.2	26.3	18.2	16.8	18.1	26.9
Average	15.0	11.9	23.1	16.5	16.9	17.3	25.9

a Winchester bushels. b Bushels of 56 pounds.

Average value per acre of rye in the United States, based upon farm value December 1, 1895–1904, by States.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Maine	$16.32	$12.06	$11.07	$15.12	$12.60	$14.10	......	......	......	......
New Hampshire	12.16	14.11	15.12	13.12	12.15	14.02	......	......	......	......
Vermont	9.12	12.09	9.60	11.08	10.54	10.13	$14.64	$13.01	$12.61	$12.51
Massachusetts	13.33	15.40	11.90	10.52	12.64	12.68	12.56	12.16	10.00	13.94
Connecticut	10.65	8.78	11.21	10.80	11.52	11.05	12.96	13.05	12.07	13.35
New York	8.69	6.29	8.88	8.75	8.96	8.46	9.24	10.15	9.27	10.80
New Jersey	6.94	6.49	8.50	7.75	8.25	8.74	8.85	10.00	8.83	12.25
Pennsylvania	7.55	7.52	8.17	7.57	7.65	8.11	9.54	8.48	9.67	11.01
Delaware	......	......	......	......	......	......	8.87	8.37	9.03	8.61
Maryland	6.32	4.42	7.82	7.83	7.98	8.58	8.06	8.12	8.08	11.25
Virginia	5.72	4.80	5.50	5.15	4.77	6.09	6.77	6.34	8.05	11.62
North Carolina	4.93	5.32	5.28	5.82	5.25	6.76	6.63	6.97	7.39	8.61
South Carolina	10.70	4.18	5.68	8.67	5.45	7.87	8.55	8.59	8.13	9.45
Georgia	6.12	7.17	6.81	7.84	6.72	7.21	8.06	6.93	9.01	8.47
Alabama	8.57	7.04	11.33	11.65	8.32	8.03	8.32	10.50	11.45	12.48
Texas	4.13	4.69	8.64	8.52	8.20	11.05	10.32	7.52	10.51	11.27
Arkansas	6.20	7.00	9.46	7.41	8.14	8.28	7.74	8.98	8.15	9.77
Tennessee	4.46	5.40	5.80	5.56	6.03	7.48	8.36	8.03	9.92	9.24
West Virginia	9.82	5.94	5.87	5.82	6.20	6.72	7.80	5.51	8.17	9.63
Kentucky	7.39	5.94	6.89	7.15	7.00	8.25	9.38	8.31	8.00	10.96
Ohio	6.66	3.74	7.92	7.83	8.80	9.13	9.30	9.27	8.87	11.91
Michigan	5.44	2.94	6.30	6.58	7.28	7.01	7.28	8.77	7.90	9.50
Indiana	5.12	3.82	5.46	6.67	6.24	7.55	7.68	6.67	6.68	10.07
Illinois	6.08	5.20	6.82	6.51	7.05	8.08	9.69	9.55	8.58	12.32
Wisconsin	5.64	4.82	6.56	6.58	7.20	7.74	8.27	9.45	8.30	11.18
Minnesota	5.91	4.68	6.36	7.79	7.56	8.19	9.46	9.59	8.28	11.33
Iowa	6.39	5.08	5.76	7.60	7.20	7.38	9.20	7.31	7.44	10.32
Missouri	4.76	5.73	5.28	6.16	6.50	7.14	9.51	8.74	7.04	9.22
Kansas	2.24	2.45	5.60	5.77	4.62	6.54	7.87	5.40	7.13	8.58
Nebraska	2.79	3.72	5.44	6.39	6.08	5.68	6.90	7.31	5.25	8.69
South Dakota	2.10	3.13	5.78	5.64	5.55	4.13	6.19	7.71	8.08	9.41
North Dakota	5.75	2.64	5.22	5.40	5.55	2.13	5.93	8.69	6.75	11.10
Montana	......	......	......	......	......	......	16.02	16.00	15.50	15.32
Wyoming	......	......	......	......	......	......	19.20	9.00	12.42	7.80
Colorado	6.96	14.57	7.80	9.00	6.72	9.07	9.98	8.90	11.16	12.41
Utah	6.93	8.00	7.20	8.97	8.16	9.10	9.23	7.56	10.46	10.72
Idaho	......	......	......	......	......	......	10.05	12.12	12.02	14.77
Washington	20.03	7.50	12.09	10.44	9.60	9.45	10.85	11.39	15.12	15.01
Oregon	6.05	7.62	8.85	10.37	7.70	9.82	10.36	9.78	13.77	12.82
California	6.73	8.70	7.93	6.30	11.70	7.54	7.30	9.00	9.47	5.93
Oklahoma	......	......	......	......	......	......	10.36	7.52	8.95	5.83
General average	6.33	5.44	7.18	7.23	7.36	7.73	8.51	8.63	8.39	10.46

Average farm price of rye per bushel in the United States December 1, 1895–1904, by States.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	85	67	82	84	84	82	......	......	......	......
New Hampshire	76	72	84	75	81	82	......	......	......	......
Vermont	57	65	60	58	62	61	80	70	65	74
Massachusetts	67	70	61	63	79	75	79	80	73	82
Connecticut	63	57	59	60	64	65	72	75	71	79
New York	48	44	48	50	56	56	62	58	61	73
New Jersey	51	47	50	50	55	55	59	61	64	70
Pennsylvania	50	47	43	47	51	53	60	53	62	71
Delaware	......	......	......	......	......	......	58	62	61	73
Maryland	49	48	46	54	57	52	56	58	59	76
Virginia	52	48	50	46	53	58	61	66	66	74
North Carolina	64	71	60	64	75	76	78	85	84	87
South Carolina	115	87	86	102	109	105	111	113	107	126
Georgia	85	101	92	98	112	103	106	110	114	102
Alabama	84	88	118	105	104	103	104	105	108	120
Texas	75	67	72	71	82	67	93	76	74	86
Arkansas	72	70	86	65	74	72	89	73	84	88
Tennessee	62	60	58	53	67	68	74	73	74	79
West Virginia	61	56	51	52	62	64	65	68	71	77
Kentucky	56	54	53	55	70	63	67	62	69	80
Ohio	45	39	44	45	55	55	55	53	58	74
Michigan	40	32	42	43	52	48	52	49	51	72
Indiana	42	36	42	43	48	50	53	46	53	69
Illinois	40	34	44	44	47	47	57	50	52	70
Wisconsin	35	33	41	43	48	49	52	50	50	69
Minnesota	28	30	37	38	42	42	49	43	45	64
Iowa	31	29	36	40	40	41	50	42	44	60

Average farm price of rye per bushel in the United States December 1, 1895–1904, by States—Continued.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Missouri	39	47	44	47	50	51	67	48	55	64
Kansas	38	35	40	37	42	43	55	45	44	65
Nebraska	30	22	32	34	38	40	46	36	37	55
South Dakota	25	27	35	34	37	39	43	41	40	57
North Dakota	27	22	36	36	37	41	43	43	43	60
Montana	......	......	......	......	......	......	60	64	63	77
Wyoming	......	......	......	......	......	......	80	50	69	40
Colorado	48	62	52	50	48	54	62	56	61	65
Utah	35	40	60	46	48	52	65	61	65	67
Idaho	......	......	......	......	......	......	67	60	65	75
Washington	75	50	62	58	60	58	62	64	72	79
Oregon	54	60	59	72	70	61	66	73	97	89
California	58	60	65	70	78	58	57	75	77	78
Oklahoma	......	......	......	......	......	......	70	47	50	62
General average	44.0	40.9	44.7	46.3	51.0	51.2	55.7	50.8	54.5	68.8

Transportation rates, average for rye in sacks, in cents per 100 pounds, St. Louis to New Orleans, by river.

1884	14.00	1891	16.28	1898	10.00
1885	15.00	1892	16.87	1899	10.00
1886	16.00	1893	17.54	1900	10.00
1887	18.25	1894	17.14	1901	10.00
1888	15.00	1895	13.00	1902	10.00
1889	17.93	1896	14.54	1903	10.00
1890	15.66	1897	10.83	1904	(a)

a No shipment.

Wholesale prices of rye per bushel in leading cities of the United States, 1900–1904.

Date.	New York.		Cincinnati.		Chicago.		Duluth.	
	Prime State.		No. 2.		No. 2.			
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1900.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	60	61¼	59	64	50	52	48½	50
February	60½	64½	61	65	51	55½	50	53
March	60½	63½	60	64	52½	55	51	53½
April	60½	63½	60	63½	53	55½	51½	52½
May	60¼	62½	61	63½	53	56¼	51¾	53¾
June	61½	68	61	67	52¾	60½	52½	60½
July	57	65	59	66	50	58	49	57½
August	54½	58	51½	60	48	51½	48	50½
September	56¾	60½	53	57	50¼	53½	50	53½
October	56	61	55	59	47¼	52¼	48	53
November	54	56	52	56	44½	48	46	48¾
December	54	56	52	55½	45¾	49¾	46¼	48½
1901.								
January	57	59	53	58½	47½	49¾	48	50
February	59½	61	56	59	48½	50¼	49¼	50½
March	60½	61	55	59	49½	51½	50¼	51¼
April	58½	60½	54	58½	48¾	53	49¾	53
May	59	61¾	57	62	51½	54	51	53
June	55	59½	55	61	46¾	53	46½	51½
July	51½	61	45	55½	47	57	46½	53½
August	59	61	52½	64	52	60	50	57¼
September	59	62	56½	60	52½	56	50	57¼
October	58	62½	56½	59½	53¼	56	50½	52½
November	63	68	57	65½	54½	61	52½	57¼
December	68½	72½	64½	73	59	65¾	57½	62½
1902.								
January	68	74	66	71½	56	67½	54	64
February	68	70	64	67	56	60½	53	57½
March	63	69	63	65	54½	58	52	54½
April	63	66	62	64	54½	57½	52	56
May	65	67	60	63½	54½	58	54	57

Wholesale prices of rye per bushel in leading cities of the United States, 1900–1904—Cont'd.

Date.	New York. Prime State.		Cincinnati. No. 2.		Chicago. No. 2.		Duluth.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1902.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
June	65	66¼	54	59	56¾	58	55¼	56½
July	65½	66½	55½	58	52¼	61½	51¼	58
August	57½	66	51	56	48	54	46	51
September	57	59¼	52½	55½	49	50½	47½	49
October	57	58⅜	52	53	48	50½	47	49
November	58	59	51	54	48½	51½	49	49¾
December	57½	59½	51	56	48	49¾	48	49¾
1903.								
January	....	....	55½	59	48	50¼	48	49
February	....	....	57½	58½	48¾	51½	48	49
March	....	....	56	58½	48¾	51½	49	49½
April	....	....	55	58	48	51	49	50½
May	....	....	54	58	48	50½	49½	50
June	....	....	57	58	49	53¾	50	52
July	....	....	56	57½	49½	51½	48½	50½
August	....	....	55	60	50½	53½	50½	52½
September	....	....	59½	63	53	60	50½	55¼
October	....	....	61	63	53	56½	52	54
November	....	....	58	62	51½	58¼	52	54
December	....	....	59	62½	50½	52½	51	52½
1904.								
January	....	....	61	64	51	57	54½	57
February	....	....	63	81	56	77	58	73
March	....	....	76	80	66½	76	63	71
April	....	....	74	78	66	72	64	68½
May	....	....	75	80	69¾	78	65	69
June	....	....	76	80	63½	75	55	67
July	....	....	73	78	63	75	55	80
August	....	....	70	76½	62	76	62	75
September	....	....	75	83	69½	75	72	77
October	....	....	81	87	75	79½	77	79¼
November	....	....	83	87	76	81	74	80
December	....	....	81	86	73	75	71	74

Monthly average prices of rye in Chicago.[a]

[Cents per bushel.]

Month.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
January	54	44¾	49¼	36⅞	36	46⅛	56⅛	51	48⅝	61¾	49⅛	54
February	52	45	51⅛	39½	34	48⅝	55⅛	53¼	49⅜	58¼	50⅛	67½
March	49½	47¼	52½	37⅝	33¼	49⅝	52¾	53¾	50½	56¼	50⅛	71¼
April	49⅛	48	60	36¼	33¾	56	55½	54¼	50⅞	56	49½	69
May	57	46⅛	64¾	34¾	34⅛	61½	59¼	54⅝	52¾	56¼	49⅛	73⅞
June	50¼	47½	63¾	31¼	33¾	45	59	57⅜	49⅞	57⅜	51⅜	69¼
July	47	44	51	30⅜	37¾	45⅝	55½	54	52	56⅞	50¼	69
August	45	45¾	42	30	48½	43¾	54	49¾	56	51	52	69
September	43½	47¼	39	33⅜	49⅛	45¾	56	51⅞	54¼	49¾	56½	72¼
October	45	47	39	37⅛	46	48	56⅛	49¾	54⅝	49¼	54¼	77¼
November	45½	47¼	36½	39½	46½	51⅛	51	46¼	57¾	50	54⅞	78⅛
December	46½	48⅞	34	39¾	46⅜	54	50½	47⅝	62⅜	48⅞	51½	74
Yearly average	48¾	46 9/16	48⅝	35 9/16	40	49½	55 1/16	52	53¼	54 5/16	51⅝	70 13/32

[a] This table exhibits average cash prices for the past twelve years. The monthly prices are the means between the lowest and highest prices for each month, and the yearly prices are the averages of the monthly averages.

BUCKWHEAT.

Condition of the buckwheat crop of the United States, monthly, 1887–1904.

Year.	Aug.	Sept.	Oct.	Year.	Aug.	Sept.	Oct.	Year.	Aug.	Sept.	Oct.	Year.	Aug.	Sept.	Oct.
1887	93.3	89.1	76.6	1892	92.9	89.0	85.6	1897	94.9	95.1	90.8	1901	91.1	90.9	90.5
1888	92.5	93.7	79.1	1893	88.8	77.5	73.5	1898	87.2	88.8	76.2	1902	91.4	86.4	80.5
1889	95.2	92.1	90.0	1894	82.3	69.2	72.0	1899	93.2	75.2	70.2	1903	93.9	91.0	83.0
1890	90.1	90.5	90.7	1895	85.2	87.5	84.8	1900	87.9	80.5	72.8	1904	92.8	91.5	88.7
1891	97.3	96.6	92.7	1896	96.0	93.2	86.0								

Acreage, production, value, and price of buckwheat in the United States, 1866–1904.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1.	Farm value, Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*
1866	1,045,624	21.8	22,791,839	67.6	15,413,160
1867	1,227,826	17.4	21,359,000	78.7	16,812,070
1868	1,113,993	17.8	19,863,700	78.0	15,490,426
1869	1,028,693	16.9	17,431,100	71.9	12,534,851
1870	536,992	18.3	9,841,500	70.5	6,937,471
1871	413,915	20.1	8,328,700	74.5	6,208,165
1872	448,497	18.1	8,133,500	73.5	5,979,222
1873	454,152	17.3	7,837,700	75.0	5,878,629
1874	452,590	17.7	8,016,600	72.9	5,843,645
1875	575,530	17.5	10,082,100	62.0	6,254,564
1876	666,441	14.5	9,668,800	66.6	6,435,836
1877	649,923	15.7	10,177,000	66.9	6,808,180
1878	673,100	18.2	12,246,820	52.6	6,441,240
1879	639,900	20.5	13,140,000	59.8	7,856,191
1880	822,802	17.8	14,617,535	59.4	8,682,488
1881	828,815	11.4	9,486,200	86.5	8,205,705
1882	847,112	13.0	11,019,353	73.0	8,038,862
1883	857,349	8.9	7,668,954	82.2	6,303,980
1884	879,403	12.6	11,116,000	58.9	6,549,020
1885	914,394	13.8	12,626,000	55.9	7,057,363
1886	917,915	12.9	11,869,000	54.5	6,465,120
1887	910,506	11.9	10,844,000	56.5	6,122,320
1888	912,630	13.2	12,050,000	63.3	7,627,647
1889	837,162	14.5	12,110,329	50.5	6,113,119
1890	844,579	14.7	12,432,831	57.4	7,132,872
1891	849,364	15.0	12,760,932	57.0	7,271,506
1892	861,451	14.1	12,143,185	51.8	6,295,643
1893	815,614	14.9	12,122,311	58.4	7,074,450
1894	789,232	16.1	12,668,200	55.6	7,040,238
1895	763,277	20.1	15,341,399	45.2	6,936,325
1896	754,898	18.7	14,089,783	39.2	5,522,339
1897	717,836	20.9	14,997,451	42.1	6,319,188
1898	678,332	17.3	11,721,927	45.0	5,271,462
1899	670,148	16.6	11,094,473	55.7	6,183,675
1900	637,930	15.0	9,566,966	55.8	5,341,413
1901	811,164	18.6	15,125,939	56.3	8,523,317
1902	804,889	18.1	14,529,770	59.6	8,654,704
1903	804,393	17.7	14,243,644	60.7	8,650,733
1904	793,625	18.9	15,008,336	62.2	9,330,768

The preceding table shows that the greatest area in buckwheat, 1,227,826 acres, was reported in 1867; the greatest production, 22,791,839 bushels, in 1866; the greatest farm value on December 1, $16,812,070, in 1867; the greatest average yield per acre, 21.8 bushels, in 1866; the greatest average farm price per bushel on December 1, 86.5 cents, in 1881. For the five years 1900–1904 the average area is 770,400 acres; the average production, 13,694,931 bushels; the average farm value on December 1, $8,100,187; the average yield per acre, 17.8 bushels; the average farm price per bushel on December 1, 59.1 cents.

Acreage, production, and value of buckwheat in the United States in 1904, by States.

States.	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Average value per acre, Dec. 1.	Farm value, Dec 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*	*Dollars.*
Maine	23,725	32.5	771,062	52	16.90	400,952
New Hampshire	1,952	25.1	48,995	68	17.07	33,317
Vermont	9,227	26.3	242,670	56	14.73	135,895
Massachusetts	2,507	16.2	40,613	72	11.66	29,241
Connecticut	3,636	16.3	59,267	73	11.90	43,265
New York	341,749	18.8	6,424,881	61	11.47	3,919,177
New Jersey	13,005	20.8	270,504	66	13.73	178,533
Pennsylvania	244,629	18.8	4,599,025	63	11.84	2,897,386
Delaware	1,475	12.1	17,848	62	7.50	11,066
Maryland	8,290	18.2	150,878	63	11.47	95,053
Virginia	19,414	17.0	330,038	64	10.88	211,224
North Carolina	5,719	14.7	84,069	71	10.44	59,689
Tennessee	578	15.5	8,959	71	11.01	6,361
West Virginia	21,131	19.1	403,602	72	13.75	290,593
Ohio	9,180	16.9	155,142	72	12.17	111,702
Michigan	35,086	15.4	540,324	61	9.39	329,598
Indiana	5,282	16.1	85,040	70	11.27	59,528
Illinois	4,574	17.9	81,875	78	13.96	63,862
Wisconsin	23,874	17.7	422,570	63	11.15	266,219
Minnesota	4,777	15.1	72,133	60	9.06	43,280
Iowa	8,015	14.8	118,622	67	9.92	79,477
Missouri	2,014	13.5	27,189	85	11.48	23,111
Kansas	1,594	14.0	22,316	80	11.20	17,853
Nebraska	935	14.7	13,744	91	13.38	12,507
North Dakota	1,257	13.5	16,970	70	9.45	11,879
United States	793,625	18.9	15,008,336	62.2	11.76	9,330,768

Average yield per acre of buckwheat in the United States, 1895–1904, by States.

States.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	38.6	42.3	35.0	26.5	22.0	30.0	31.7	30.4	29.8	32.5
New Hampshire	29.9	27.2	27.0	20.0	20.0	22.0	21.0	20.0	19.6	25.1
Vermont	34.5	31.4	24.0	21.4	23.0	25.0	25.1	25.0	24.0	26.3
Massachusetts	15.0	18.3	19.0	20.0	20.0	17.0	18.9	14.4	13.7	16.2
Connecticut	15.4	14.2	17.0	19.0	19.0	16.0	18.0	18.4	17.5	16.3
New York	21.4	18.8	22.0	16.8	13.0	14.0	18.8	17.7	18.3	18.8
New Jersey	18.7	20.7	16.0	21.0	21.0	16.0	19.0	22.5	18.1	20.8
Pennsylvania	19.9	17.3	21.0	17.2	20.0	14.0	19.5	18.1	16.5	18.8
Delaware	10.0	20.0	19.0	16.5	18.0	13.0	17.8	15.2	15.2	12.1
Maryland	10.9	22.7	19.0	12.2	13.0	15.0	17.5	17.0	16.3	18.2
Virginia	10.1	18.0	14.0	17.2	14.0	13.0	15.9	16.6	18.6	17.0
North Carolina	12.0	20.0	11.0	19.5	17.0	13.0	15.6	14.5	12.1	14.7
Tennessee	10.0	24.0	18.0	18.0	12.0	14.0	14.2	18.0	14.7	15.5
West Virginia	18.8	19.5	19.0	20.5	17.0	17.0	20.6	22.5	17.2	19.1
Ohio	14.6	18.8	18.0	20.0	16.0	16.0	16.1	13.9	16.6	16.9
Michigan	17.2	15.3	17.0	14.2	11.0	14.0	14.1	13.0	15.5	15.4
Indiana	14.3	24.0	14.0	18.4	16.0	14.0	13.1	17.6	16.8	16.1
Illinois	13.3	13.8	13.0	14.0	15.0	15.0	11.0	15.5	15.3	17.9
Wisconsin	17.9	13.5	18.0	15.5	15.0	14.0	12.4	16.0	15.6	17.7
Minnesota	15.3	10.6	17.0	15.0	17.0	15.0	14.5	13.9	15.2	15.1
Iowa	13.5	16.2	17.0	16.0	16.0	15.0	13.5	16.0	15.1	14.8
Missouri	10.2	21.8	15.0	15.8	14.0	13.0	6.0	16.0	14.8	13.5
Kansas	......	......	......	......	......	......	7.9	12.0	18.4	14.0
Nebraska	6.7	21.3	14.0	12.8	16.0	16.0	11.5	14.7	19.0	14.7
North Dakota	......	......	......	......	......	......	11.5	10.0	12.7	13.5
Oregon	15.5	21.0	18.0	14.0	17.0	13.0	......	......	......	......
General average	20.1	18.7	20.9	17.3	16.6	15.0	18.6	18.1	17.7	18.9

Average value per acre of buckwheat in the United States, based upon farm value December 1, 1895–1904, by States.

States.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Maine	$17.76	$16.07	$15.40	$10.34	$9.68	$14.70	$15.22	$15.81	$15.20	$16.90
New Hampshire	14.05	17.20	14.85	9.40	10.00	11.44	11.55	13.00	11.56	17.07
Vermont	12.77	12.56	11.04	9.84	11.96	12.50	14.81	14.00	13.20	14.73
Massachusetts	8.85	9.70	12.54	12.20	14.00	12.24	11.53	10.66	9.32	11.66
Connecticut	8.62	7.24	9.69	10.64	11.97	10.40	11.70	13.06	12.42	11.90
New York	9.42	6.96	8.80	7.56	7.67	7.98	10.72	10.44	10.80	11.47
New Jersey	9.35	8.07	7.84	11.34	11.76	9.44	9.88	14.40	11.58	13.73
Pennsylvania	8.76	6.57	8.82	7.57	10.80	7.70	10.92	11.04	10.56	11.84
Delaware	5.00	6.00	6.84	6.60	8.82	6.76	9.79	9.12	8.36	7.50
Maryland	6.10	11.12	9.69	6.47	7.28	8.55	10.50	10.37	10.27	11.47
Virginia	5.45	8.46	7.00	7.79	7.56	7.15	8.90	9.96	11.35	10.88
North Carolina	5.28	12.00	5.39	9.36	8.33	7.28	9.67	8.99	7.86	10.44
Tennessee	5.40	14.88	10.26	9.36	6.84	8.26	8.38	13.68	9.70	11.01
West Virginia	10.72	9.75	9.31	10.05	9.52	9.52	12.15	13.95	11.70	13.75
Ohio	8.03	8.08	9.00	10.20	9.28	9.28	9.66	8.48	10.79	12.17
Michigan	7.40	5.81	6.46	5.96	6.05	7.14	7.19	6.89	8.37	9.39
Indiana	8.29	12.24	6.86	9.38	9.44	8.54	7.99	10.21	11.76	11.27
Illinois	5.85	6.21	7.41	7.28	8.70	9.75	7.70	11.01	11.17	13.96
Wisconsin	8.23	5.13	6.84	6.20	9.45	8.26	7.32	9.44	9.52	11.15
Minnesota	7.80	4.35	7.65	7.35	8.84	8.55	8.99	7.92	8.06	9.06
Iowa	6.75	7.45	8.33	7.69	9.28	9.60	9.45	11.20	10.72	9.92
Missouri	5.92	15.26	9.00	9.48	8.54	8.97	4.56	9.34	11.10	11.48
Kansas	......	......	......	......	......	......	5.92	9.00	14.35	11.20
Nebraska	4.36	10.65	7.14	7.81	9.92	10.24	6.67	7.79	13.11	13.38
North Dakota	......	......	......	......	......	......	6.90	5.40	6.73	9.45
Oregon	7.75	14.28	9.90	8.12	12.58	10.01	......	......	......	......
General average	9.09	7.32	8.80	7.77	9.23	8.37	10.51	10.75	10.75	11.76

Average farm price of buckwheat per bushel in the United States, December 1, 1895–1904, by States.

States.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	46	38	44	39	44	49	48	52	51	52
New Hampshire	47	63	55	47	50	52	55	65	59	68
Vermont	37	40	46	46	52	50	59	56	55	56
Massachusetts	59	53	66	61	70	72	61	74	68	72
Connecticut	56	51	57	56	63	65	65	71	71	73
New York	44	37	40	45	59	57	57	59	59	61
New Jersey	50	39	49	54	56	59	52	64	64	66
Pennsylvania	44	38	42	44	54	55	56	61	64	63
Delaware	50	30	36	40	49	52	55	60	55	62
Maryland	56	49	51	53	56	57	60	61	63	63
Virginia	54	47	50	45	54	55	56	60	61	64
North Carolina	44	60	49	48	49	56	62	62	65	71
Tennessee	54	62	57	52	57	59	59	76	66	71
West Virginia	57	50	49	49	56	56	59	62	68	72
Ohio	55	43	50	51	58	58	60	61	65	72
Michigan	43	38	38	42	55	51	51	53	54	61
Indiana	58	51	49	51	59	61	61	58	70	70
Illinois	44	45	57	52	58	65	70	71	73	78
Wisconsin	46	38	38	40	63	59	59	59	61	63
Minnesota	51	41	45	49	52	57	62	57	53	60
Iowa	50	46	49	48	58	64	70	70	71	67
Missouri	58	70	60	60	61	69	76	58	75	85
Kansas	......	......	......	......	......	......	75	75	78	80
Nebraska	65	50	51	61	62	64	58	53	69	91
North Dakota	......	......	......	......	......	......	60	54	53	70
Oregon	50	68	55	58	74	77	......	......	......	......
General average	45.2	39.2	42.1	45.0	55.7	55.8	56.3	59.6	60.7	62.2

POTATOES.

Condition of the potato crop of the United States, monthly, 1889–1904.

Year.	July.	Aug.	Sept.	Oct.	Year.	July.	Aug.	Sept.	Oct.
1889	95.1	94.3	81.7	77.9	1897	87.8	77.9	66.7	61.6
1890	91.7	77.4	65.7	61.7	1898	95.5	83.9	77.7	72.5
1891	95.3	96.5	94.8	91.3	1899	93.8	93.0	86.3	81.7
1892	90.0	86.8	74.8	67.7	1900	91.3	88.2	80.0	74.4
1893	94.8	86.0	71.8	71.2	1901	87.4	62.3	52.2	54.0
1894	92.3	74.0	62.4	64.3	1902	92.9	94.8	89.1	82.5
1895	91.5	89.7	90.8	87.4	1903	88.1	87.2	84.3	74.6
1896	99.0	94.8	83.2	81.7	1904	93.9	94.1	91.6	89.5

Acreage, production, value, prices, exports, etc., of potatoes of the United States, 1866–1904.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1	Farm value, Dec. 1.	Chicago price per bushel, Burbank. December. Low.	December. High.	May of following year. Low.	May of following year. High.	Domestic exports, fiscal years beginning July 1.	Imports during fiscal years beginning July 1.
	Acres.	*Bush.*	*Bushels.*	*Cts.*	*Dollars.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Bushels.*	*Bushels.*
1866	1,069,381	100.2	107,200,976	47.3	50,722,553	......	......	......	......	512,380	198,265
1867	1,192,195	82.0	97,783,000	65.9	64,462,486	......	......	......	......	378,605	209,555
1868	1,131,552	93.8	106,090,000	59.3	62,918,660	......	......	......	......	508,249	138,470
1869	1,222,250	109.5	133,886,000	42.9	57,481,362	......	......	......	......	596,968	75,336
1870	1,325,119	86.6	114,775,000	65.0	74,621,019	......	......	......	......	553,070	458,758
1871	1,220,912	98.7	120,461,700	53.9	64,905,189	......	......	......	......	621,537	96,259
1872	1,331,331	85.3	113,516,000	53.5	60,692,129	......	......	......	......	515,306	346,840
1873	1,295,139	81.9	106,089,000	65.2	69,153,709	......	......	......	......	497,413	549,073
1874	1,310,041	80.9	105,981,000	61.5	65,223,314	......	......	......	......	609,642	188,757
1875	1,510,041	110.5	166,877,000	34.4	57,357,515	......	......	......	......	704,379	92,148
1876	1,741,983	71.7	124,827,000	61.9	77,319,541	......	......	......	......	529,650	3,205,555
1877	1,792,287	94.9	170,092,000	43.7	74,272,500	......	......	......	......	744,409	528,584
1878	1,776,800	69.9	124,126,650	58.7	72,923,575	......	......	......	......	625,342	2,624,149
1879	1,836,800	98.9	181,626,400	43.6	79,153,673	......	......	......	......	696,080	721,868
1880	1,842,510	91.0	167,659,570	48.3	81,062,214	......	......	......	......	638,840	2,170,372
1881	2,041,670	53.5	109,145,494	91.0	99,291,341	......	......	......	......	408,286	8,789,860
1882	2,171,636	78.7	170,972,508	55.7	95,304,844	......	......	......	......	439,443	2,362,362
1883	2,289,275	90.9	208,164,425	42.2	87,849,991	......	......	......	......	554,613	425,408
1884	2,220,980	85.8	190,642,000	39.6	75,524,290	......	......	......	......	380,868	658,633
1885	2,265,823	77.2	175,029,000	44.7	78,153,403	......	......	33	50	494,948	1,937,416
1886	2,287,136	73.5	168,051,000	46.7	78,441,940	44	47	65	90	434,864	1,432,490
1887	2,357,322	56.9	134,103,000	68.2	91,506,740	70	83	65	85	403,880	8,259,538
1888	2,533,280	79.9	202,365,000	40.2	81,413,589	30	37	24	45	471,955	883,380
1889	2,647,989	77.4	204,881,441	35.4	72,610,934	33	45	30	60	406,618	3,415,578
1890	2,651,579	55.9	148,289,696	75.8	112,341,708	82	93	95	110	341,189	5,401,912
1891	2,714,770	93.7	254,423,607	35.8	91,012,962	30	40	30	50	557,022	186,871
1892	2,547,962	61.5	156,654,819	66.1	103,567,520	60	72	70	98	845,720	4,317,021
1893	2,605,186	70.3	183,034,203	59.4	108,661,801	51	60	64	88	803,111	3,002,578
1894	2,737,973	62.4	170,787,338	53.6	91,526,787	43	58	40	70	572,957	1,341,533
1895	2,954,952	100.6	297,237,370	26.6	78,984,901	18	24	10	23	680,049	175,240
1896	2,767,465	91.1	252,234,540	28.6	72,182,350	18	26	19	26	926,646	246,178
1897	2,534,577	64.7	164,015,964	54.7	89,643,059	50	62	60	87	605,187	1,171,378
1898	2,557,729	75.2	192,306,338	41.4	79,574,772	30	36	33	52	579,833	530,420
1899	2,581,353	88.6	228,783,232	39.0	89,328,832	35	46	27	39	809,472	155,861
1900	2,611,054	80.8	210,926,897	43.1	90,811,167	40	48	35	60	741,483	371,911
1901	2,864,335	65.5	187,598,087	76.7	143,979,470	75	82	58	100	528,484	7,656,162
1902	2,965,587	96.0	284,632,787	47.1	134,111,436	42	48	42	60	843,075	358,505
1903	2,916,855	84.7	247,127,880	61.4	151,638,094	60	66	32	38	484,042	3,166,581
1904	3,015,675	110.4	332,830,300	45.3	150,673,392	95	116	......	......	....	....

The preceding table shows that the greatest area in potatoes, 3,015,675 acres, was reported in 1904; the greatest production, 332,830,300 bushels, in the same year; the greatest farm value on December 1, $151,638,094, in 1903; the greatest yield per acre, 110.5 bushels, in 1875; the greatest average farm price per bushel on December 1, 91 cents, in 1881. For the five years 1900–1904 the average area is 2,874,701 acres; the average production, 252,623,190 bushels; the average farm value on December 1, $134,242,712; the average yield per acre, 87.9 bushels; the average farm price per bushel on December 1, 53.1 cents.

Acreage, production, and value of potatoes in the United States in 1904, by States.

States and Territories.	Acreage.	Average yield per acre.	Production.	Average farm price Dec. 1.	Average value per acre Dec. 1.	Farm value Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*	*Dollars.*
Maine	91,431	215	19,657,665	48	103.20	9,435,679
New Hampshire	19,922	135	2,689,470	56	75.60	1,506,103
Vermont	27,388	128	3,505,664	47	60.16	1,647,662
Massachusetts	29,740	119	3,539,060	71	84.49	2,512,733
Rhode Island	6,832	137	935,984	76	104.12	711,348
Connecticut	32,254	96	3,096,384	72	69.12	2,229,396
New York	442,254	93	41,129,622	54	50.22	22,209,996
New Jersey	62,876	115	7,230,740	61	70.15	4,410,751
Pennsylvania	256,361	106	27,174,266	54	57.24	14,674,104
Delaware	7,601	84	638,484	53	44.52	338,397
Maryland	29,939	99	2,963,961	51	50.49	1,511,620
Virginia	52,986	83	4,397,838	55	45.65	2,418,811
North Carolina	25,627	78	1,998,906	70	54.60	1,399,234
South Carolina	8,726	88	767,888	101	88.88	775,567
Georgia	8,542	70	597,940	107	74.90	639,796
Florida	3,454	102	352,308	129	131.58	454,477
Alabama	9,450	61	576,450	99	60.39	570,686
Mississippi	5,748	82	471,336	85	69.70	400,636
Louisiana	8,710	70	609,700	91	63.70	554,827
Texas	31,196	72	2,246,112	93	66.96	2,088,884
Arkansas	22,612	77	1,741,124	75	57.75	1,305,843
Tennessee	24,583	71	1,745,393	62	44.02	1,082,144
West Virginia	34,036	101	3,437,636	54	54.54	1,856,323
Kentucky	35,803	83	2,971,649	55	45.65	1,634,407
Ohio	163,566	98	16,029,468	47	46.06	7,533,850
Michigan	262,865	121	31,806,665	29	35.09	9,223,933
Indiana	80,225	93	7,460,925	45	41.85	3,357,416
Illinois	147,670	108	15,948,360	47	50.76	7,495,729
Wisconsin	249,997	126	31,499,622	28	35.28	8,819,894
Minnesota	137,215	102	13,995,930	29	29.58	4,058,820
Iowa	164,368	136	22,354,048	28	38.08	6,259,133
Missouri	85,237	96	8,182,752	48	46.08	3,927,721
Kansas	69,257	80	5,540,560	56	44.80	3,102,714
Nebraska	85,435	120	10,252,200	26	31.20	2,665,572
South Dakota	33,086	96	3,176,256	30	28.80	952,877
North Dakota	24,926	111	2,766,786	32	35.52	885,372
Montana	13,162	143	1,882,166	61	87.23	1,148,121
Wyoming	3,848	161	619,528	62	99.82	384,107
Colorado	54,311	159	8,635,449	37	58.83	3,195,116
New Mexico	1,336	62	82,832	78	48.36	64,609
Utah	12,483	137	1,710,171	48	65.76	820,882
Nevada	2,724	131	356,844	65	85.15	231,949
Idaho	11,439	139	1,590,021	63	87.57	1,001,713
Washington	29,999	120	3,599,880	56	67.20	2,015,933
Oregon	37,489	87	3,261,543	59	51.33	1,924,310
California	47,001	129	6,063,129	67	86.43	4,062,296
Oklahoma	10,125	85	860,625	77	65.45	662,681
Indian Territory	9,840	69	678,960	75	51.75	509,220
United States	3,015,675	110.4	332,830,300	45.3	49.96	150,673,392

Average yield per acre of potatoes in the United States, 1895–1904, by States.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	163	165	59	130	139	126	150	130	196	215
New Hampshire	134	108	51	90	127	101	108	120	98	135
Vermont	154	128	70	105	132	134	90	94	138	128
Massachusetts	133	108	62	97	134	79	77	109	96	119
Rhode Island	138	105	110	123	142	94	98	164	125	137
Connecticut	128	106	54	100	130	96	81	92	96	96
New York	122	89	62	73	88	81	78	66	89	93
New Jersey	94	94	68	75	83	69	59	132	99	115
Pennsylvania	111	109	63	54	85	58	62	83	91	106
Delaware	58	78	60	49	52	48	55	79	84	84
Maryland	87	90	74	58	64	55	60	80	70	99
Virginia	73	93	61	68	66	58	71	75	84	83
North Carolina	79	79	66	67	57	61	64	64	67	78
South Carolina	90	52	65	65	56	78	70	69	81	88
Georgia	58	55	52	54	46	68	64	58	73	70
Florida	55	75	75	64	69	60	62	90	82	102
Alabama	70	64	55	74	56	69	67	50	67	61
Mississippi	58	70	59	74	61	66	62	69	82	82

Average yield per acre of potatoes in the United States, 1895–1904, by States—Cont'd.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Louisiana	89	55	64	78	60	70	60	65	50	70
Texas	89	52	60	78	64	62	54	66	67	72
Arkansas	70	59	55	74	63	72	46	72	70	77
Tennessee	64	62	40	52	44	54	46	62	66	71
West Virginia	69	93	56	62	72	80	52	96	80	101
Kentucky	86	85	47	64	51	70	35	80	73	83
Ohio	63	89	42	61	71	76	54	94	83	98
Michigan	101	88	72	79	66	97	81	72	78	121
Indiana	66	85	31	71	76	83	31	101	76	93
Illinois	77	97	38	70	96	92	35	118	72	108
Wisconsin	107	78	99	98	103	103	75	115	58	126
Minnesota	158	84	106	85	96	81	68	98	64	102
Iowa	106	94	60	80	100	72	32	98	56	136
Missouri	109	78	42	66	82	93	17	128	66	96
Kansas	72	69	48	70	95	72	26	138	58	80
Nebraska	67	90	69	65	94	66	33	137	64	120
South Dakota	66	96	94	72	78	73	45	74	89	96
North Dakota	128	102	99	87	103	52	110	105	84	111
Montana	53	170	156	104	141	134	157	153	176	143
Wyoming	100	167	150	120	125	99	113	100	167	161
Colorado	95	88	97	77	84	56	120	100	145	159
New Mexico	80	72	90	58	49	19	50	72	87	62
Utah	172	155	148	135	120	118	114	157	177	137
Nevada	150	190	135	155	102	156	141	212	117	131
Idaho	105	162	140	120	124	136	108	149	160	139
Washington	149	125	162	108	144	116	117	136	145	120
Oregon	64	87	160	86	115	110	90	103	107	87
California	75	80	105	95	119	104	101	118	130	129
Oklahoma	......	......	......	......	......	......	55	97	78	85
Indian Territory	......	......	......	......	......	......	63	85	70	69
General average	100.6	91.1	64.7	75.2	88.6	80.8	65.5	96.0	84.7	110.4

Average value per acre of potatoes in the United States, based upon farm value December 1, 1895–1904, by States.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Maine	$55.42	$62.70	$52.51	$59.80	$58.38	$61.74	$100.50	$84.50	$109.76	$103.20
New Hampshire	42.88	50.76	45.90	44.10	58.42	53.53	85.32	82.80	63.70	75.60
Vermont	40.04	37.12	49.00	44.10	47.52	53.60	57.60	54.52	69.00	60.16
Massachusetts	63.84	61.56	55.80	61.11	76.38	52.14	69.30	88.29	68.16	84.49
Rhode Island	62.10	56.70	106.70	78.72	71.00	65.80	91.14	123.00	102.50	104.12
Connecticut	52.48	48.76	48.60	55.00	59.80	67.20	76.14	67.16	74.88	69.12
New York	28.06	27.59	41.54	30.66	35.20	36.45	55.38	38.94	49.84	50.22
New Jersey	31.96	33.84	53.04	45.75	42.33	41.40	50.15	80.52	68.31	70.15
Pennsylvania	31.08	29.43	41.58	31.32	36.55	30.74	47.12	47.31	56.42	57.24
Delaware	22.04	27.30	39.00	33.81	26.52	28.80	42.90	40.29	47.04	44.52
Maryland	26.10	27.00	50.32	30.74	32.64	29.70	46.20	41.60	42.00	50.49
Virginia	27.74	31.62	42.70	37.40	36.96	34.22	52.54	43.50	53.76	45.65
North Carolina	43.45	33.97	42.24	41.54	37.62	39.65	46.08	42.88	49.58	54.60
South Carolina	65.70	34 32	68.25	65.00	58.24	78.00	77.00	66.24	84.24	88.88
Georgia	41.18	41.25	52.00	40.50	38.18	52.36	67.84	52.20	68.62	74.90
Florida	55.00	63.00	90.00	76.80	85.56	63.60	79.98	109.80	103.32	131.58
Alabama	56.70	48.00	51.70	61.42	48.72	56.58	73.03	46.50	64.32	60.39
Mississippi	37.12	43.40	48.38	53.28	62.22	54.78	71.30	63.48	72.16	69.70
Louisiana	64.08	41.80	54.40	58.50	48.60	55.30	60.60	53.30	45.50	63.70
Texas	69.42	40.56	57.00	67.08	58.24	54.56	67.50	56.10	58.96	66.96
Arkansas	35.70	31.27	46.20	40.70	44.73	41.04	57.96	48.96	55.30	57.75
Tennessee	25.60	24.80	29.20	29.64	28.60	31.32	39.56	39.68	42.24	44.02
West Virginia	28.98	28.83	36.40	33.48	37.44	40.80	44.20	48.96	52.80	54.54
Kentucky	33.54	28.05	31.49	29.44	31.11	35.00	30.45	42.40	49.64	45.65
Ohio	20.16	24.14	26.04	25.01	30.53	30.40	45.90	41.36	50.63	46.06
Michigan	16.16	16.72	30.96	21.33	21.12	25.22	55.08	29.52	38.22	35.09
Indiana	20.46	21.25	19.22	29.11	32.68	31.54	27.90	41.41	50.16	41.85
Illinois	23.10	25.22	23.56	32.20	39.36	37.72	32.55	49.56	51.84	50.76
Wisconsin	18.19	14.82	37.62	23.52	26.78	28.84	50.25	37.95	33.64	35.28
Minnesota	22.12	17.64	32.86	21.25	24.00	24.30	45.56	30.38	39.04	29.58
Iowa	20.14	20.68	28.20	24.00	23.00	26.64	30.08	33.32	42.00	38.08
Missouri	27.25	24.18	26.46	29.04	33.20	32.55	18.02	44.80	50.16	46.08
Kansas	30.24	18.63	26.40	35.70	42.75	34.56	27.04	62.10	49.30	44.80
Nebraska	20.10	22.50	31.74	24.05	23.50	32.34	34.65	36.99	41.60	31.20
South Dakota	17.16	19.20	30.08	20.16	21.06	26.28	38.25	32.56	48.06	28.80
North Dakota	21.76	21.42	32.67	29.58	27.81	25.48	53.90	34.65	40.32	35.52
Montana	25.44	54.40	62.40	57.20	74.73	71.02	114.61	76.50	77.44	87.23
Wyoming	56.00	71.81	82.50	78.00	76.25	67.32	112.40	65.27	95.19	99.82

Average value per acre of potatoes in the United States, based upon farm value December 1, 1895–1904, by States—Continued.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Colorado	$31.35	$41.36	$54.32	$41.58	$46.20	$45.92	$108.00	$51.00	$87.00	$58.83
New Mexico	50.40	48.96	70.20	45.24	33.32	21.66	59.00	58.32	73.08	48.36
Utah	58.48	49.60	44.40	41.85	66.00	56.64	68.40	70.65	83.19	65.76
Nevada	57.00	72.20	98.55	139.50	91.80	87.36	128.31	133.56	81.90	85.15
Idaho	42.00	48.60	44.80	64.80	75.64	63.92	90.72	55.13	73.60	87.57
Washington	41.72	50.00	45.36	42.14	72.00	54.52	71.37	51.68	52.20	67.20
Oregon	24.96	33.93	64.00	40.42	56.35	49.50	63.00	56.65	53.50	51.33
California	36.00	42.40	51.45	52.25	74.97	55.12	77.77	68.44	85.80	86.43
Oklahoma	......	......	......	......	......	......	69.30	74.69	76.44	65.45
Indian Territory	......	......	......	......	......	......	78.12	54.40	60.20	51.75
General average	26.73	26.08	35.37	31.11	34.60	34.78	50.27	45.22	51.99	49.96

Average farm price of potatoes per bushel in the United States December 1, 1895–1904, by States.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	34	38	89	46	42	49	67	65	56	48
New Hampshire	32	47	90	49	46	53	79	69	65	56
Vermont	26	29	70	42	36	40	64	58	50	47
Massachusetts	48	57	90	63	57	66	90	81	71	71
Rhode Island	45	54	97	64	50	70	93	75	82	76
Connecticut	41	46	90	55	46	70	94	73	78	72
New York	23	31	67	42	40	45	71	59	56	54
New Jersey	34	36	78	61	51	60	85	61	69	61
Pennsylvania	28	27	66	58	43	53	76	57	62	54
Delaware	38	35	65	69	51	60	78	51	56	53
Maryland	30	30	68	53	51	54	77	52	60	51
Virginia	38	34	70	55	56	59	74	58	64	55
North Carolina	55	43	64	62	66	65	72	67	74	70
South Carolina	73	66	105	100	104	100	110	96	104	101
Georgia	71	75	100	75	83	77	106	90	94	107
Florida	100	84	120	120	124	106	129	122	126	129
Alabama	81	75	94	83	87	82	109	93	96	99
Mississippi	64	62	82	72	102	83	115	92	88	85
Louisiana	72	76	85	75	81	79	101	82	91	91
Texas	78	78	95	86	91	88	125	85	88	93
Arkansas	51	53	84	55	71	57	126	68	79	75
Tennessee	40	40	73	57	65	58	86	64	64	62
West Virginia	42	31	65	54	52	51	85	51	66	54
Kentucky	39	33	67	46	61	50	87	53	68	55
Ohio	32	26	62	41	43	40	85	44	61	47
Michigan	16	19	43	27	32	26	68	41	49	29
Indiana	31	25	62	41	43	38	90	41	66	45
Illinois	30	26	62	46	41	41	93	42	72	47
Wisconsin	17	19	38	24	26	28	67	33	58	28
Minnesota	14	21	31	25	25	30	67	31	61	29
Iowa	19	22	47	30	23	37	94	34	75	28
Missouri	25	31	63	44	40	35	106	35	76	48
Kansas	42	27	55	51	45	48	104	45	85	56
Nebraska	30	25	46	37	25	49	105	27	65	26
South Dakota	26	20	32	28	27	36	85	44	54	30
North Dakota	17	21	33	34	27	49	49	33	48	32
Montana	48	32	40	55	53	53	73	50	44	61
Wyoming	56	43	55	65	61	68	100	61	57	62
Colorado	33	47	56	54	55	82	90	51	60	37
New Mexico	63	68	78	78	68	114	118	81	84	78
Utah	34	32	30	31	55	48	60	45	47	48
Nevada	38	38	73	90	90	56	91	63	70	65
Idaho	40	30	32	54	61	47	84	37	46	63
Washington	28	40	28	39	50	47	61	38	36	56
Oregon	39	39	40	47	49	45	70	55	50	59
California	48	53	49	55	63	53	77	58	66	67
Oklahoma	......	......	......	......	......	......	126	77	98	77
Indian Territory	......	......	......	......	......	......	124	64	86	75
General average	26.6	28.6	54.7	41.4	39.0	43.1	76.7	47.1	61.4	45.3

Wholesale prices of potatoes per bushel in leading cities of the United States, 1900–1904.

Date.	Cincinnati. Per bushel. Low.	Cincinnati. Per bushel. High.	Chicago. Burbank, per bushel. Low.	Chicago. Burbank, per bushel. High.	Milwaukee. Per bushel. Low.	Milwaukee. Per bushel. High.	St. Louis. Burbank, per bushel. Low.	St. Louis. Burbank, per bushel. High.
1900.			*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	$0.45	$0.57	40	50	25	40	43	52
February	.45	.55	40	49	25	42	43	50
March	.43	.50	35	45	25	45	35	46
April	.32	.45	26	37	20	38	27	40
May	.33	.50	27	39	20	35	30	45
June	.35	.50	31	41	20	80	36	45
July	....	....	....	....	20	55	....	....
August	....	....	....	....	30	40	....	....
September	.40	.45	30	40	28	38	32	40
October	.32	.40	25	37	23	35	32	38
November	.38	.47	29	46	23	42	33	48
December	.40	.50	40	48	30	50	45	54
1901.								
January	.42	.50	40	49	38	50	45	54
February	.40	.48	38	43	35	50	18	20
March	.30	.47	38	42	35	45	37	43
April	.35	.45	30	42	32	45	41	45
May	.38	.75	35	60	35	60	39	53
June	.64	.90	35	78	30	80	50	80
July	....	....	....	....	65	125	....	....
August	.95	1.10	110	125	85	135	....	....
September	.75	1.20	56	107	40	110	70	140
October	.40	.75	59	68	40	75	70	75
November	.60	.95	59	82	60	82	83	100
December	.78	.90	75	82	65	87	83	83
1902.	Per barrel.							
January	2.20	2.40	70	80	72	87	78	83
February	2.10	2.40	68	76	72	85	78	84
March	2.10	2.60	68	80	70	85	76	90
April	2.45	3.00	72	100	70	103	81	105
May	2.25	3.00	58	100	50	103	90	105
June	2.10	2.40	47	60	40	90	72	80
July	.90	2.40	....	....	30	85	....	....
August	.90	1.05	....	....	28	50	....	....
September	.95	1.35	30	38	28	40	....	....
October	1.25	1.35	30	44	30	40	41	44
November	1.50	1.60	42	48	34	43	50	54
December	1.35	1.50	42	48	35	43	51	55
1903.								
January	1.65	1.80	45	48	40	45	50	55
February	1.50	1.60	45	47	38	40	51	54
March	1.50	1.70	43	47	35	40	50	53
April	1.35	1.65	38	46	35	40	42	54
May	1.65	1.90	42	60	35	52	45	63
June	1.50	3.00	50	85	46	90	65	125
July	1.75	2.25	....	....	35	75	40	65
August	1.75	1.95	....	....	40	70	....	....
September	1.50	1.80	....	....	35	60	....	....
October	1.20	1.80	54	60	45	60	55	72
November	1.20	2.10	50	70	50	65	67	80
December	1.80	2.10	60	66	55	65	65	68
1904.								
January	1.95	2.55	62	95	50	85	69	73
February	2.70	2.85	85	91	78	85	90	96
March	2.80	4.50	86	102	83	95	94	97
April	3.75	4.80	89	122	90	120	115	125
May	3.30	4.80	95	116	75	118	105	115
June	2.70	4.50	115	118	75	120	....	....
July	2.00	3.00	....	....	40	90	....	....
August	1.50	1.80	....	....	30	60	....	....
September	1.35	1.65	....	....	28	78	47	52
October	1.20	1.50	31	40	25	33	42	45
November	1.20	1.50	32	42	20	30	36	43
December	1.20	1.35	32	38	20	30	36½	45

HAY.

Condition of the hay crop of the United States, monthly, 1889-1904.

Year.	Clover.		Timothy.		Year.	Clover.		Timothy.	
	June.	July.	July.	Aug.		June.	July.	July.	Aug.
1889	......	......	......	94.5	1897	96.0	......	......	......
1890	95.1	94.0	93.9	93.6	1898	......	......	......	99.3
1891	91.0	89.3	87.4	90.9	1899	......	......	......	86.7
1892	94.9	95.5	96.8	93.2	1900	......	......	......	79.9
1893	92.7	92.6	89.8	89.6	1901	......	......	......	84.1
1894	87.8	80.2	77.3	75.6	1902	......	86.3	84.9	90.0
1895	82.8	73.9	70.8	69.9	1903	82.7	84.2	84.0	92.2
1896	88.4	83.7	84.8	87.5	1904	94.0	91.4	92.8	94.0

Acreage, production, value, prices, and exports of hay of the United States, 1866-1904.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per ton, Dec. 1.	Farm value, Dec. 1.	Chicago prices No. 1 timothy per ton, by carload lots.				Domestic exports, fiscal years beginning July 1.
						December.		May of following year.		
						Low.	High.	Low.	High.	
	Acres.	*Tons.*	*Tons.*	*Dolls.*	*Dollars.*	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*	*Tons.*
1866	17,668,904	1.23	21,778,627	10.14	220,835,771	......	......	......	......	5,028
1867	20,020,554	1.31	26,277,000	10.21	268,300,623	......	......	......	......	5,645
1868	21,541,573	1.21	26,141,900	10.08	263,589,235	......	......	......	......	......
1869	18,591,281	1.42	26,420,000	10.18	268,933,048	......	......	......	......	6,723
1870	19,861,805	1.23	24,525,000	12.47	305,743,224	......	......	......	......	4,581
1871	19,009,052	1.17	22,239,400	14.30	317,939,799	......	......	......	......	5,266
1872	20,318,936	1.17	23,812,800	12.94	308,024,517	......	......	......	......	4,557
1873	21,894,084	1.15	25,085,100	12.53	314,241,037	......	......	......	......	4,889
1874	21,769,772	1.15	25,133,900	11.94	300,222,454	......	......	......	......	7,183
1875	23,507,964	1.19	27,873,600	10.78	300,377,839	......	......	......	......	7,528
1876	25,282,797	1.22	30,867,100	8.97	276,991,422	......	......	9.00	10.00	7,287
1877	25,367,708	1.25	31,629,300	8.37	264,879,796	9.50	10.50	9.75	10.75	9,514
1878	26,931,300	1.47	39,608,296	7.20	285,015,625	8.00	8.50	9.00	11.50	8,127
1879	27,484,991	1.29	35,493,000	9.32	330,804,494	14.00	14.50	14.00	15.00	13,739
1880	25,863,955	1.23	31,925,233	11.65	371,811,084	15.00	15.50	17.00	19.00	12,662
1881	30,888,700	1.14	35,135,064	11.82	415,131,366	16.00	16.50	15.00	16.50	10,570
1882	32,339,585	1.18	38,138,049	9.70	371,170,326	11.50	12.25	12.00	13.00	13,309
1883	35,515,948	1.32	46,864,009	8.19	384,834,451	9.00	10.00	12.50	17.00	16,908
1884	38,571,593	1.26	48,470,460	8.17	396,139,309	10.00	11.50	15.50	17.50	11,142
1885	39,849,701	1.12	44,731,550	8.71	389,752,873	11.00	12.00	10.00	12.00	13,390
1886	36,501,688	1.15	41,796,499	8.46	353,437,699	9.50	10.50	11.00	12.50	13,873
1887	37,664,739	1.10	41,454,458	9.97	413,440,283	13.50	14.50	17.00	21.00	18,198
1888	38,591,903	1.21	46,643,094	8.76	408,499,565	11.00	11.50	10.50	11.00	21,928
1889	52,947,236	1.26	66,829,612	7.04	470,374,948	9.00	10.00	9.00	14.00	36,274
1890	50,712,513	1.19	60,197,589	7.87	473,569,972	9.00	10.50	12.50	15.50	28,066
1891	51,044,490	1.19	60,817,771	8.12	494,113,616	12.50	15.00	13.50	14.00	35,201
1892	50,853,061	1.18	59,823,735	8.20	490,427,798	11.00	11.50	12.00	13.50	33,084
1893	49,613,469	1.33	65,766,158	8.68	570,882,872	10.00	10.50	10.00	10.50	54,446
1894	48,321,272	1.14	54,874,408	8.54	468,578,321	10.00	11.00	10.00	10.25	47,117
1895	44,206,453	1.06	47,078,541	8.35	393,185,615	12.00	12.50	11.50	12.00	59,052
1896	43,259,756	1.37	59,282,158	6.55	388,145,614	8.00	8.50	8.50	9.00	61,658
1897	42,426,770	1.43	60,664,876	6.62	401,390,728	8.00	8.50	9.50	10.50	81,827
1898	42,780,827	1.55	66,376,920	6.00	398,060,647	8.00	8.25	9.50	10.50	64,916
1899	41,328,462	1.35	56,655,756	7.27	411,926,187	10.50	11.50	10.50	12.50	72,716
1900	39,132,890	1.28	50,110,906	8.89	445,538,870	11.50	14.00	12.00	13.50	89,364
1901	39,390,508	1.28	50,590,877	10.01	506,191,533	12.50	13.90	13.00	14.00	153,431
1902	39,825,227	1.50	59,857,576	9.06	542,036,364	12.00	13.00	13.50	15.00	50,970
1903	39,933,759	1.54	61,305,940	9.08	556,376,880	10.00	12.00	12.50	13.00	60,734
1904	39,998,602	1.52	60,696,028	8.72	529,107,625	10.50	11.50	......	......	......

The preceding table shows that the greatest area devoted to hay, 52,947,236 acres, was reported in 1889; the greatest production, 66,829,612 tons, in the same year; the greatest farm value on December 1, $570,882,872, in 1893; the greatest average yield per acre, 1.55 tons, in 1898; the greatest average farm price per ton on December 1, $14.30, in 1871. For the five years 1900-1904 the average area is 39,656,197 acres; the average production, 56,512,265 tons; the average farm value on December 1, $515,850,254; the average yield per acre, 1.43 tons; the average farm price per ton on December 1, $9.13.

Acreage, production, and value of hay in the United States in 1904, by States.

States and Territories.	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Average value per acre, Dec. 1.	Farm value, Dec. 1.
	Acres.	*Tons.*	*Tons.*	*Dollars.*	*Dollars.*	*Dollars.*
Maine	1,290,852	1.10	1,419,937	9.72	10.69	13,801,788
New Hampshire	625,788	1.02	638,304	13.49	13.76	8,610,721
Vermont	870,617	1.25	1,088,271	9.48	11.85	10,316,809
Massachusetts	582,890	1.23	716,955	15.76	19.38	11,299,211
Rhode Island	65,242	1.16	75,681	17.38	20.16	1,315,336
Connecticut	484,751	1.06	513,836	14.89	15.78	7,651,018
New York	4,765,294	1.36	6,480,800	10.44	14.20	67,659,552
New Jersey	424,568	1.39	590,150	14.67	20.39	8,657,500
Pennsylvania	3,103,052	1.45	4,499,425	11.82	17.14	53,183,204
Delaware	77,091	1.59	122,575	13.89	22.09	1,702,567
Maryland	301,064	1.36	409,447	12.48	16.97	5,109,899
Virginia	458,820	1.39	637,760	12.55	17.44	8,003,888
North Carolina	128,197	1.72	220,499	14.56	25.04	3,210,465
South Carolina	60,706	1.53	92,880	12.18	18.64	1,131,278
Georgia	89,851	1.52	136,574	15.14	23.01	2,067,730
Florida	12,499	1.36	16,999	16.67	22.67	283,373
Alabama	56,372	1.71	96,396	12.13	20.74	1,169,283
Mississippi	45,277	1.72	77,876	10.85	18.66	844,955
Louisiana	21,488	2.06	44,265	12.20	25.13	540,033
Texas	407,900	1.77	721,983	8.12	14.37	5,862,502
Arkansas	78,595	1.72	135,183	9.82	16.89	1,327,497
Tennessee	349,944	1.66	580,907	12.01	19.94	6,976,693
West Virginia	533,276	1.47	783,916	12.41	18.24	9,728,398
Kentucky	485,298	1.44	698,829	11.51	16.57	8,043,522
Ohio	2,713,453	1.43	3,880,238	9.25	13.23	35,892,202
Michigan	2,126,883	1.25	2,658,604	9.09	11.36	24,166,710
Indiana	1,751,155	1.37	2,399,082	8.58	11.75	20,584,124
Illinois	2,747,095	1.36	3,736,049	8.66	11.78	32,354,184
Wisconsin	1,772,271	1.67	2,959,693	7.89	13.18	23,351,978
Minnesota	867,136	1.74	1,508,817	5.51	9.59	8,313,582
Iowa	3,132,322	1.62	5,074,362	5.36	8.68	27,198,580
Missouri	2,992,267	1.47	4,398,632	6.62	9.73	29,118,944
Kansas	1,795,246	1.67	2,998,061	4.38	7.31	13,131,507
Nebraska	578,821	1.76	1,018,725	3.82	6.72	3,891,530
South Dakota	202,768	1.43	289,958	4.24	6.06	1,229,422
North Dakota	156,410	1.57	245,564	4.21	6.61	1,033,824
Montana	348,980	1.92	670,042	8.70	16.70	5,829,365
Wyoming	176,501	2.27	400,657	5.75	13.05	2,303,778
Colorado	671,945	1.85	1,243,098	6.71	12.41	8,341,188
New Mexico	71,897	2.58	185,494	11.42	29.46	2,118,341
Arizona	60,652	2.71	164,367	14.84	40.22	2,439,206
Utah	354,820	3.54	1,256,063	6.31	22.34	7,925,758
Nevada	159,042	3.04	483,488	7.60	23.10	3,674,509
Idaho	374,968	3.07	1,151,152	6.08	18.67	6,999,004
Washington	325,705	2.18	710,037	11.34	24.72	8,051,820
Oregon	378,715	2.04	772,579	10.18	20.77	7,864,854
California	583,286	2.03	1,184,071	10.41	21.13	12,326,179
Oklahoma	293,337	1.51	442,939	4.90	7.40	2,170,401
Indian Territory	43,495	1.49	64,808	4.62	6.88	299,413
United States	39,998,602	1.52	60,696,028	8.72	13.23	529,107,625

Average yield per acre of hay in the United States, 1895–1904, by States.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Maine	1.02	1.00	1.10	1.20	0.90	0.90	1.05	1.07	0.98	1.10
New Hampshire	.95	.96	1.15	1.25	.89	.87	1.28	1.06	.92	1.02
Vermont	1.07	1.25	1.30	1.45	1.14	1.24	1.36	1.27	1.18	1.25
Massachusetts	1.11	1.28	1.40	1.42	1.13	.97	1.21	1.60	1.36	1.23
Rhode Island	.91	1.10	1.15	1.18	.89	.92	.92	1.03	1.07	1.16
Connecticut	.85	1.07	1.20	1.31	.94	.89	1.01	1.35	1.11	1.06
New York	.73	.81	1.35	1.40	1.04	.81	1.30	1.34	1.26	1.36
New Jersey	1.21	1.15	1.75	1.42	.83	1.26	1.32	1.22	1.28	1.39
Pennsylvania	1.01	1.06	1.40	1.45	1.20	1.10	1.19	1.19	1.27	1.45
Delaware	1.23	1.10	1.35	1.38	1.04	.98	1.12	1.09	1.64	1.59
Maryland	1.25	.87	1.35	1.20	1.13	1.09	1.22	1.01	1.24	1.36
Virginia	1.13	1.08	1.08	1.32	1.10	1.16	1.20	1.06	1.30	1.39
North Carolina	1.63	1.26	1.25	1.70	1.50	1.41	1.66	1.44	1.60	1.72
South Carolina	1.00	1.33	1.00	1.60	1.22	1.32	1.46	1.22	1.46	1.53
Georgia	1.60	1.38	1.35	1.75	1.45	1.69	1.46	1.36	1.53	1.52
Florida	1.53	1.40	1.00	1.60	1.46	1.20	1.48	1.24	1.47	1.36
Alabama	1.56	1.40	1.45	1.90	1.66	1.85	1.75	1.50	1.77	1.71

Average yield per acre of hay in the United States, 1895–1904, by States—Continued.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Mississippi	1.95	1.35	1.48	1.90	1.44	1.75	1.69	1.40	1.74	1.72
Louisiana	2.02	1.90	1.90	2.10	1.95	2.00	1.85	1.80	2.04	2.06
Texas	1.48	1.00	1.40	1.50	1.43	1.80	1.25	1.40	1.84	1.77
Arkansas	1.20	1.18	1.30	1.54	1.48	1.63	1.10	1.60	1.60	1.72
Tennessee	1.39	1.40	1.45	1.50	1.31	1.40	1.52	1.44	1.58	1.66
West Virginia	.71	1.22	1.35	1.54	1.29	1.18	1.37	1.12	1.38	1.47
Kentucky	1.35	1.20	1.17	1.45	1.29	1.40	1.34	1.44	1.46	1.44
Ohio	.58	1.26	1.44	1.39	1.30	1.06	1.36	1.43	1.42	1.43
Michigan	.58	1.16	1.49	1.36	1.22	1.29	1.26	1.45	1.37	1.25
Indiana	.61	1.30	1.43	1.45	1.34	1.21	1.27	1.46	1.47	1.37
Illinois	.66	1.38	1.29	1.56	1.29	1.27	1.08	1.50	1.54	1.36
Wisconsin	.88	1.25	1.35	1.50	1.47	1.15	1.29	1.90	1.89	1.67
Minnesota	1.30	1.69	1.57	1.80	1.70	1.16	1.55	1.76	1.84	1.74
Iowa	1.08	1.74	1.50	1.75	1.34	1.42	1.25	1.68	1.78	1.62
Missouri	1.17	1.43	1.15	1.60	1.37	1.29	.75	1.59	1.57	1.47
Kansas	1.24	1.42	1.30	1.46	1.57	1.32	.91	1.70	1.58	1.67
Nebraska	.99	1.66	1.60	1.60	1.66	1.38	1.25	1.74	1.68	1.76
South Dakota	.79	1.28	1.25	1.38	1.43	1.18	1.15	1.23	1.45	1.43
North Dakota	1.42	1.65	1.60	1.50	1.58	.92	1.60	1.66	1.18	1.57
Montana	.94	1.38	1.50	1.45	1.42	1.60	1.79	1.68	2.08	1.92
Wyoming	1.08	1.55	1.65	1.96	1.47	1.68	1.76	1.65	2.14	2.27
Colorado	2.42	2.20	2.25	2.20	2.10	2.23	2.08	1.92	2.56	1.85
New Mexico	2.61	3.00	3.50	3.75	1.70	2.06	2.31	2.40	2.36	2.58
Arizona	1.85	3.20	3.00	3.50	2.63	2.31	2.85	2.34	3.46	2.71
Utah	2.56	2.70	2.95	3.25	2.50	2.65	2.45	2.62	2.95	3.54
Nevada	3.01	2.55	2.50	2.60	1.87	2.43	2.50	2.91	3.12	3.04
Idaho	2.57	2.60	2.30	3.75	2.50	2.80	2.58	2.67	2.82	3.07
Washington	1.85	1.95	2.25	1.75	2.02	2.16	2.30	2.29	2.41	2.18
Oregon	1.78	1.98	1.90	1.90	1.97	2.35	2.07	2.04	2.07	2.04
California	1.66	1.65	1.60	1.60	1.63	1.51	1.82	1.81	2.08	2.03
Oklahoma	......	......	......	......	......	......	.96	1.26	1.34	1.51
Indian Territory	......	......	......	......	......	......	1.46	1.32	1.50	1.49
General average	1.06	1.37	1.43	1.55	1.35	1.28	1.28	1.50	1.54	1.52

Average value per acre of hay in the United States, based upon farm value December 1, 1895–1904, by States.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Maine	$9.87	$10.25	$10.73	$9.12	$9.09	$11.66	$10.96	$10.74	$10.00	$10.69
New Hampshire	11.88	12.38	13.23	11.56	10.46	13.48	15.87	14.36	12.20	13.76
Vermont	13.11	12.85	12.03	9.21	10.55	13.70	13.36	12.26	12.84	11.85
Massachusetts	19.42	20.99	19.46	17.18	17.52	16.88	21.16	26.64	22.74	19.38
Rhode Island	15.70	18.26	16.67	14.93	15.35	17.20	17.54	19.46	20.28	20.16
Connecticut	13.68	15.74	15.60	14.61	13.63	14.89	14.77	21.19	16.86	15.78
New York	10.00	9.75	11.14	8.05	10.87	11.38	13.75	14.11	13.81	14.20
New Jersey	15.29	16.50	18.81	13.63	12.74	20.22	18.86	19.08	19.70	20.39
Pennsylvania	12.42	12.88	12.81	11.46	13.80	15.29	15.90	16.66	17.15	17.14
Delaware	14.96	14.30	13.50	11.66	12.12	13.67	13.84	15.73	24.32	22.09
Maryland	14.44	10.31	14.17	11.16	13.73	15.31	16.07	14.19	17.38	16.97
Virginia	12.92	11.03	11.07	11.22	11.27	15.43	14.41	14.39	17.85	17.44
North Carolina	16.53	13.55	12.19	15.81	15.15	15.79	17.93	17.64	21.47	25.04
South Carolina	7.92	15.06	11.50	15.20	12.56	15.18	16.03	13.72	17.11	18.64
Georgia	17.44	15.25	17.55	20.56	19.07	21.55	20.92	18.22	23.18	23.01
Florida	20.24	18.20	14.25	22.56	22.41	16.44	22.72	19.02	27.67	22.67
Alabama	15.93	13.72	13.86	17.57	18.92	19.52	21.12	17.42	21.93	20.74
Mississippi	18.91	12.77	14.06	15.96	13.32	17.41	17.62	14.35	20.18	18.66
Louisiana	19.47	16.63	16.62	19.74	18.92	18.80	20.50	21.10	23.15	25.13
Texas	9.52	7.20	10.15	8.77	10.15	12.24	13.27	12.04	15.09	14.37
Arkansas	11.12	8.90	11.25	10.39	12.80	14.43	12.89	15.04	15.17	16.89
Tennessee	15.05	13.54	15.59	14.25	14.74	16.52	18.71	16.99	19.42	19.94
West Virginia	9.04	11.94	11.95	12.94	12.19	15.81	18.91	16.05	19.04	18.24
Kentucky	14.77	11.35	11.70	13.19	13.42	15.89	16.25	16.27	17.62	16.57
Ohio	7.40	9.99	9.00	7.99	11.63	11.71	11.86	14.59	14.20	13.23
Michigan	7.59	9.84	11.55	9.72	10.37	12.19	10.85	12.03	12.23	11.36
Indiana	7.34	9.33	8.44	8.12	10.45	11.80	11.79	12.66	12.58	11.75
Illinois	6.77	8.82	7.93	9.20	10.00	10.67	12.10	13.31	12.83	11.78
Wisconsin	8.47	8.25	8.44	8.62	10.07	11.10	13.58	15.03	14.17	13.18
Minnesota	6.66	6.41	7.06	6.66	7.40	8.06	8.65	9.43	12.16	9.59
Iowa	6.97	6.94	6.37	7.09	7.10	9.66	9.59	10.92	9.72	8.68
Missouri	7.96	6.94	7.07	9.28	8.56	8.97	8.99	10.96	10.49	9.73
Kansas	4.04	3.83	4.42	4.74	5.49	6.01	7.25	7.33	7.60	7.31
Nebraska	3.52	4.05	4.80	5.28	6.14	7.11	7.71	7.59	7.53	6.72
South Dakota	2.60	3.99	3.69	4.14	4.43	4.66	5.16	5.10	6.71	6.06
North Dakota	4.94	5.59	5.20	4.87	5.21	5.20	5.84	6.09	5.48	6.61
Montana	10.72	9.47	11.63	9.86	10.93	13.92	14.60	12.67	18.32	16.70

Average value per acre of hay in the United States, based upon farm value December 1, 1895–1904, by States—Continued.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Wyoming	$7.02	$11.07	$9.90	$11.40	$9.70	$12.26	$12.64	$12.01	$14.27	$13.05
Colorado	14.21	13.68	12.38	11.88	15.43	16.95	18.80	18.99	19.15	12.41
New Mexico	20.88	17.10	24.50	27.56	18.02	20.39	23.89	26.83	26.24	29.46
Arizona	16.65	28.00	15.00	42.00	27.22	26.10	26.16	28.62	35.78	40.22
Utah	13.49	13.50	14.01	14.62	17.75	21.07	20.70	19.18	20.18	22.34
Nevada	20.32	12.29	12.50	18.20	14.31	18.71	19.80	29.73	31.11	23.10
Idaho	16.06	12.25	12.08	18.37	15.75	18.20	15.25	14.69	19.64	18.67
Washington	12.49	13.83	20.25	13.30	17.98	20.52	19.60	20.45	30.78	24.72
Oregon	10.89	13.07	14.73	13.78	13.49	15.98	14.82	15.26	21.07	20.77
California	11.72	10.48	14.40	22.80	13.04	12.31	14.41	17.03	24.25	21.13
Oklahoma	......	......	......	......	......	......	6.59	6.68	7.52	7.40
Indian Territory	......	......	......	......	......	......	11.01	6.57	8.86	6.88
General average	8.89	8.97	9.46	9.30	9.97	11.39	12.85	13.61	13.93	13.23

Average farm price of hay per ton in the United States December 1, 1895–1904, by States.

States and Territories.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Maine	$9.68	$10.25	$9.75	$7.60	$10.10	$12.95	$10.44	$10.04	$10.20	$9.72
New Hampshire	12.50	12.90	11.50	9.25	11.75	15.50	12.40	13.55	13.26	13.49
Vermont	12.25	10.28	9.25	6.35	9.25	11.05	9.82	9.65	10.88	9.48
Massachusetts	17.50	16.40	13.90	12.10	15.50	17.40	17.49	16.65	16.72	15.76
Rhode Island	17.25	16.60	14.50	12.65	17.25	18.70	19.06	18.89	18.95	17.38
Connecticut	16.10	14.71	13.00	11.15	14.50	16.73	14.62	15.70	15.19	14.89
New York	13.70	12.04	8.25	5.75	10.45	14.05	10.58	10.53	10.96	10.44
New Jersey	12.64	14.35	10.75	9.60	15.35	16.05	14.29	15.64	15.39	14.67
Pennsylvania	12.30	12.15	9.15	7.90	11.50	13.90	13.64	14.00	13.50	11.82
Delaware	12.16	13.00	10.00	8.45	11.65	13.95	12.36	14.43	14.83	13.89
Maryland	11.55	11.85	10.50	9.30	12.15	14.05	13.17	14.05	14.02	12.48
Virginia	11.43	10.21	10.25	8.50	10.25	13.30	12.01	13.58	13.73	12.55
North Carolina	10.14	10.75	9.75	9.30	10.10	11.20	10.80	12.25	13.42	14.56
South Carolina	7.62	11.32	11.50	9.50	10.30	11.50	10.98	11.25	11.72	12.18
Georgia	10.90	11.05	13.00	11.75	13.15	12.75	14.33	13.40	15.15	15.14
Florida	13.23	13.00	14.25	14.10	15.35	13.70	15.35	15.34	18.82	16.67
Alabama	10.21	9.80	10.25	9.25	11.40	10.55	12.07	11.61	12.39	12.13
Mississippi	9.70	9.46	9.50	8.40	9.25	9.95	10.51	10.25	11.60	10.85
Louisiana	9.64	8.75	8.75	9.40	9.70	9.40	11.08	11.72	11.35	12.20
Texas	6.43	7.20	7.75	5.85	7.10	6.80	10.62	8.60	8.20	8.12
Arkansas	9.27	7.54	8.65	6.75	8.65	8.85	11.72	9.40	9.48	9.82
Tennessee	10.83	9.67	10.75	9.50	11.25	11.80	12.31	11.80	12.29	12.01
West Virginia	12.73	9.79	8.85	8.40	9.45	13.40	13.80	14.33	13.80	12.41
Kentucky	10.94	9.46	10.00	9.10	10.40	11.35	12.13	11.30	12.07	11.51
Ohio	12.76	7.93	6.25	5.75	8.95	11.05	8.72	10.20	10.00	9.25
Michigan	13.09	8.48	7.75	7.15	8.50	9.45	8.61	8.30	8.93	9.09
Indiana	12.03	7.18	5.90	5.60	7.80	9.75	9.28	8.67	8.56	8.58
Illinois	10.25	6.39	6.15	5.90	7.75	8.40	11.20	8.87	8.33	8.66
Wisconsin	9.63	6.60	6.25	5.75	6.85	9.65	10.53	7.91	7.50	7.89
Minnesota	5.12	3.79	4.50	3.70	4.35	6.95	5.58	5.36	6.61	5.51
Iowa	6.45	3.99	4.25	4.05	5.30	6.80	7.67	6.50	5.46	5.36
Missouri	6.80	4.85	6.15	5.80	6.25	6.95	11.99	6.89	6.68	6.62
Kansas	3.26	2.70	3.40	3.25	3.50	4.55	7.67	4.31	4.81	4.38
Nebraska	3.56	2.44	3.00	3.30	3.70	5.15	6.17	4.36	4.48	3.82
South Dakota	3.29	3.12	2.95	3.00	3.10	3.95	4.49	4.15	4.63	4.24
North Dakota	3.48	3.39	3.25	3.25	3.30	5.65	3.65	3.67	4.64	4.21
Montana	11.40	6.86	7.75	6.80	7.70	8.70	8.18	7.54	8.81	8.70
Wyoming	6.50	7.14	6.00	5.90	6.60	7.30	7.18	7.28	6.67	5.75
Colorado	5.87	6.22	5.50	5.40	7.35	7.60	9.04	9.89	7.48	6.71
New Mexico	8.00	5.70	7.00	7.35	10.60	9.90	10.34	11.18	11.12	11.42
Arizona	9.00	8.75	5.00	12.00	10.35	11.30	9.18	12.23	10.84	14.84
Utah	5.27	5.00	4.75	4.50	7.10	7.95	8.45	7.32	6.84	6.31
Nevada	6.75	4.82	5.00	7.00	7.65	7.70	7.92	9.05	9.97	7.60
Idaho	6.25	4.71	5.25	4.90	6.30	6.50	5.91	5.50	6.86	6.08
Washington	6.75	7.09	9.00	7.60	8.90	9.50	8.52	8.93	12.77	11.34
Oregon	6.12	6.60	7.75	7.25	6.85	6.80	7.16	7.48	10.18	10.18
California	7.06	6.35	9.00	14.25	8.00	8.15	7.92	9.41	11.66	10.41
Oklahoma	......	......	......	......	......	......	6.86	5.30	5.61	4.90
Indian Territory	......	......	......	......	......	......	7.54	4.98	5.91	4.62
General average	8.35	6.55	6.62	6.00	7.27	8.89	10.01	9.06	9.08	8.72

Wholesale prices of hay (baled) per ton in leading cities of the United States, 1900–1904.

Date.	Chicago.		Cincinnati.		St. Louis.	
	No. 1 timothy, per ton.		No. 1 timothy, per ton.		No. 1 timothy, per ton.	
	Low.	High.	Low.	High.	Low.	High.
1900.						
January	$10.50	$11.00	$13.00	$14.00	$11.00	$12.50
February	10.50	10.75	13.50	14.00	10.50	12.00
March	10.50	11.00	13.75	14.25	11.00	12.50
April	11.00	13.00	14.50	15.00	11.50	13.00
May	11.50	12.00	14.25	15.00	11.00	13.50
June	10.00	11.00	14.00	14.75	10.50	13.50
July	10.50	12.00	13.75	14.25	11.00	14.50
August	11.00	11.50	11.50	15.00	9.75	13.00
September	11.00	11.50	12.50	13.75	10.00	12.00
October	11.00	11.50	13.50	14.50	11.00	12.50
November	12.00	13.50	13.50	14.00	10.75	13.50
December	12.50	13.50	13.75	14.50	11.50	14.00
1901.						
January	12.00	13.00	14.00	14.50	11.50	13.50
February	12.00	12.50	14.00	14.25	11.50	12.75
March	12.00	13.00	13.50	14.50	11.50	14.00
April	12.50	13.00	14.00	15.50	12.50	14.50
May	12.50	13.50	14.25	14.50	12.00	14.50
June	12.50	13.00	12.50	13.50	12.00	15.50
July	13.00	14.00	12.25	15.00	12.50	17.50
August	13.00	14.00	12.25	15.00	13.00	16.00
September	12.00	12.50	12.50	13.25	12.50	15.50
October	12.00	12.50	12.50	13.25	12.50	14.50
November	13.00	13.50	12.50	13.25	13.00	14.50
December	13.00	13.50	13.00	14.00	13.50	15.00
1902.						
January	12.50	13.00	12.50	13.75	13.50	15.50
February	12.00	12.50	12.50	13.25	13.00	14.50
March	12.00	12.50	12.75	13.25	13.00	14.50
April	12.50	13.00	12.75	13.25	13.00	15.25
May	12.50	13.50	13.00	13.50	13.00	15.50
June	12.00	12.50	12.75	13.00	12.00	15.00
July	12.00	12.50	13.75	15.50	13.00	16.00
August	12.00	12.50	12.00	15.50	10.00	15.00
September	12.00	12.50	11.00	13.00	9.50	12.00
October	12.00	12.50	13.00	14.00	11.00	13.00
November	12.00	12.50	13.00	14.00	11.00	13.50
December	12.00	12.50	13.75	16.50	13.50	15.50
1903.						
January	12.00	13.00	15.50	17.25	13.50	15.50
February	12.00	13.00	16.00	16.75	13.50	15.00
March	12.00	13.50	16.00	17.50	14.00	16.00
April	13.00	15.00	16.25	18.00	13.50	16.00
May	13.50	15.00	15.25	18.00	13.00	16.00
June	13.00	15.00	17.50	19.50	14.50	25.00
July	13.00	13.50	16.50	18.00	9.50	16.50
August	11.00	13.50	11.50	17.00	10.00	15.00
September	10.00	12.00	11.50	13.50	10.00	12.00
October	10.00	11.50	12.50	13.25	10.00	12.50
November	10.00	11.50	12.25	12.75	10.00	12.50
December	10.00	12.00	12.50	13.00	10.00	13.50
1904.						
January	10.50	12.50	12.50	13.25	10.00	11.50
February	10.50	12.50	12.50	13.50	10.50	11.50
March	10.50	13.00	12.50	14.00	10.50	12.00
April	11.50	14.50	13.75	14.00	11.00	13.00
May	12.00	15.00	14.00	15.50	12.50	13.00
June	12.00	15.00	13.00	14.00	12.00	13.50
July	10.00	14.00	12.00	13.75	12.00	13.00
August	10.00	15.00	11.50	14.00	11.50	13.50
September	9.00	12.00	11.00	12.25	10.50	12.50
October	10.00	12.50	11.50	12.50	10.50	12.50
November	10.00	12.50	11.25	12.00	11.00	11.50
December	10.50	12.50	12.00	12.50	10.50	11.50

COTTON.

Commercial cotton crop of 1903–1904.

[In commercial bales.]

States and Territories.	Movement and mill purchases.			Taken from other States and ports.			Total commercial crop.
	Forwarded by rail, etc.	Bought by mills.	Total.	Taken from other States.	Taken from ports.	Total.	
Alabama	856,135	217,760	1,073,895	67,496	17,545	85,041	988,854
Arkansas	798,733	1,807	800,540	46,462	....	46,462	754,078
Florida	49,832	....	49,832	499	....	499	49,333
Georgia	1,123,073	412,824	1,535,897	219,252	10,654	229,906	1,305,991
Indian Territory	282,238	....	282,238	2,663	....	2,663	279,575
Kansas	33	....	33	....	....	....	33
Kentucky	861	19,458	20,319	19,458	....	19,458	861
Louisiana	900,946	14,777	915,723	72,761	14,777	87,538	828,185
Mississippi	1,481,208	29,804	1,511,012	85,665	479	86,144	1,424,868
Missouri	40,612	4,535	45,147	4,535	....	4,535	40,612
North Carolina	313,524	497,572	811,096	209,296	27,472	236,768	574,328
Oklahoma	170,764	....	170,764	673	....	673	170,091
South Carolina	477,007	569,559	1,046,566	184,763	30,425	215,188	831,378
Tennessee	250,988	43,146	294,134	40,156	2,863	43,019	251,115
Texas	2,632,526	15,120	2,647,646	109,138	....	109,138	2,538,508
Virginia	13,143	50,660	63,803	50,660	....	50,660	13,143
United States	9,391,623	1,877,022	11,268,645	1,113,477	104,215	1,217,692	10,050,953

Value of the commercial crop of 1903–1904.

States and Territories.	Upland crop.				Sea-island crop.				Total value.
	Production.	Weight per bale.	Price per pound.	Value.	Production.	Weight per bale.	Price per pound.	Value.	
	Bales.	*Lbs.*	*Cents.*	*Dollars.*	*Bales.*	*Lbs.*	*Cents.*	*Dollars.*	*Dollars.*
Alabama	988,854	499.5	11.54	56,999,819	......	......	......	......	56,999,819
Arkansas	754,078	513.3	12.01	46,486,895	......	......	......	......	46,486,895
Florida	21,328	447.2	11.84	1,129,285	28,005	382.0	22.50	2,407,030	3,536,315
Georgia	1,266,836	485.3	11.84	72,791,788	39,155	384.0	21.50	3,232,637	76,024,425
Indian Territory	279,575	515.9	11.89	17,149,273	......	......	......	......	17,149,273
Kansas	33	500.0	12.01	1,982	......	......	......	......	1,982
Kentucky	861	541.0	11.89	55,384	......	......	......	......	55,384
Louisiana	828,185	504.2	11.88	49,607,420	......	......	......	......	49,607,420
Mississippi	1,424,868	507.8	11.88	85,957,499	......	......	......	......	85,957,499
Missouri	40,612	523.4	12.01	2,552,884	......	......	......	......	2,552,884
North Carolina	574,328	476.0	12.01	32,832,953	......	......	......	......	32,832,953
Oklahoma	170,091	499.0	11.89	10,091,686	......	......	......	......	10,091,686
South Carolina	821,829	483.5	11.66	46,331,514	9,549	347.3	26.75	887,128	47,218,642
Tennessee	251,115	517.0	11.89	15,436,365	......	......	......	......	15,436,365
Texas	2,538,508	513.5	11.89	154,988,987	......	......	......	......	154,988,987
Virginia	13,143	477.8	12.01	754,195	......	......	......	......	754,195
United States	9,974,244	502.1	11.85	593,167,929	76,709	378.7	22.47	6,526,795	599,694,724

Condition of the cotton crop of the United States, monthly, 1889–1904.

Year.	June.	July.	August.	September.	October.	Year.	June.	July.	August.	September.	October.
1889	86.4	87.6	89.3	86.6	81.5	1897	83.5	86.0	86.9	78.3	70.0
1890	88.8	91.4	89.5	85.5	80.0	1898	89.0	91.2	91.2	79.8	75.4
1891	85.7	88.6	88.9	82.7	75.7	1899	85.7	87.8	84.0	68.5	62.4
1892	85.9	86.9	82.3	76.8	73.3	1900	82.5	75.8	76.0	68.2	67.0
1893	85.6	82.7	80.4	73.4	70.7	1901	81.5	81.1	77.2	71.4	61.4
1894	88.3	89.6	91.8	85.9	82.7	1902	95.1	84.7	81.9	64.0	58.3
1895	81.0	82.3	77.9	70.8	65.1	1903	74.1	77.1	79.7	81.2	65.1
1896	97.2	92.5	80.1	64.2	60.7	1904	83.0	88.0	91.6	84.1	75.8

Acreage, production, value, prices, and exports of cotton of the United States, 1879–1904.

Year.	Acreage.	Production.	Value.[b]	New York closing prices per pound on middling upland. December. Low.	December. High.	May of following year. Low.	May of following year. High.	Domestic exports fiscal years beginning July 1.
	Acres.	*Bales.*	*Dollars.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Bales of 500 pounds.*
1879–1880	12,595,500	5,761,252	248,482,799	.....	.....	.....	.....	....
1880–1881	15,475,300	6,605,750	297,787,210	11 7/8	12	10 7/16	10 7/8	4,381,857
1881–1882	16,710,730	5,456,048	245,522,160	11 7/8	12 1/8	12 1/16	12 3/8	3,479,952
1882–1883	16,276,691	6,949,756	323,372,147	10 1/4	10 7/16	10 1/2	11 1/8	4,576,150
1883–1884	16,777,993	5,713,200	237,554,856	10 3/8	10 9/16	11 1/2	11 3/4	3,725,145
1884–1885	17,439,612	5,706,165	241,484,903	10 7/16	11 7/16	10 11/16	11	3,783,319
1885–1886	18,300,865	6,575,691	268,786,319	9 3/16	9 7/16	9 3/16	9 5/16	4,116,075
1886–1887	18,454,603	6,505,087	247,505,550	9 3/16	9 9/16	10 3/4	11 7/16	4,338,915
1887–1888	18,641,067	7,046,833	279,724,036	10 1/2	10 5/8	9 15/16	10 1/16	4,528,242
1888–1889	19,058,591	6,938,290	281,312,968	9 3/4	9 7/8	11	11 3/16	4,769,633
1889–1890	20,171,896	7,311,322	290,069,389	10 1/4	10 1/4	11 15/16	12 3/4	4,943,600
1890–1891	20,809,053	8,652,597	351,970,341	9 3/16	9 7/16	8 7/8	8 15/16	5,814,717
1891–1892	20,714,937	9,035,379	311,982,601	7 3/4	8 1/16	7 1/4	7 7/16	5,870,440
1892–1893	18,067,924	6,700,365	267,344,564	9 3/8	10	7 5/8	7 13/16	4,424,230
1893–1894	19,525,000	7,549,817	250,145,067	7 13/16	8 1/16	7 1/8	7 3/8	5,366,565
1894–1895	23,687,950	[a]9,476,435	259,164,640	5 11/16	5 13/16	6 3/4	7 3/8	7,034,866
1895–1896	20,184,808	[a]7,161,094	293,358,852	8 1/4	8 9/16	8	8 3/8	4,670,453
1896–1897	23,273,209	[a]8,532,705	291,811,564	7 1/16	7 11/16	7 5/8	7 13/16	6,207,516
1897–1898	24,319,584	[a]10,897,857	319,491,412	5 13/16	5 15/16	6 5/16	6 9/16	7,725,572
1898–1899	24,967,295	[a]11,189,205	305,467,041	5 5/8	5 7/8	6 1/8	6 1/4	7,575,838
1899–1900	23,403,153	[a]9,142,838	334,847,868	7 1/8	7 3/4	9	9 7/8	6,201,166
1900–1901	25,758,139	[a]10,401,453	511,098,111	9 3/4	10 5/16	8 1/16	8 5/16	6,661,781
1901–1902	27,220,414	[a]10,662,995	418,358,366	8	8 3/4	9 3/8	9 3/4	7,001,558
1902–1903	27,114,103	[a]10,725,422	458,051,005	8 1/2	8 7/8	12 3/4	13 9/16	7,086,086
1903–1904	28,016,893	[a]10,050,953	599,694,724	6 17/20	9	.....	.....	....

[a] Commercial crop.
[b] From 1879–1880 to 1893–1894, inclusive, the farm value on December 1 is given, and for other years the commercial value.

Cotton acreage from 1898–1899 to 1903–1904, inclusive.

States and Territories.	1898–1899.	1899–1900.	1900–1901.	1901–1902.	1902–1903.	1903–1904.
	Acres.	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*
Virginia	51,162	35,302	30,572	35,145	36,843	39,864
North Carolina	1,311,708	1,219,888	1,091,034	1,112,260	1,075,743	1,155,028
South Carolina	2,353,213	2,212,020	2,195,252	2,248,569	2,205,016	2,318,100
Georgia	3,535,205	3,287,741	3,783,015	4,006,199	3,863,542	4,048,912
Florida	152,452	149,403	235,451	254,596	253,961	268,666
Alabama	3,003,176	2,883,049	3,403,746	3,642,964	3,501,614	3,608,049
Mississippi	2,900,298	2,784,286	3,194,795	3,193,570	3,183,989	3,327,960
Louisiana	1,281,691	1,179,156	1,480,781	1,586,124	1,617,586	1,642,463
Texas	6,991,904	6,642,309	7,178,915	7,656,312	7,640,531	7,801,578
Arkansas	1,876,467	1,726,350	1,742,787	1,854,482	1,901,758	1,925,191
Tennessee	896,722	734,415	662,612	737,337	754,600	783,196
Missouri	82,318	41,340	49,504	54,628	59,341	66,496
Oklahoma	215,893	208,553	255,446	306,750	358,391	326,391
Indian Territory	314,906	299,161	453,560	530,923	658,699	702,966
Utah	35	40	30	....	....	....
Kansas	8	414	311	380	122	76
Kentucky	137	70	328	175	2,367	1,957
Total	24,967,295	23,403,497	25,758,139	27,220,414	27,114,103	28,016,893

COTTON IN EAST AFRICA.

The report early in 1905 of the commissioner sent out by the British Government to investigate the cotton growing possibilities in East Africa made the following statement:

Unless difficulties, which at the present are insuperable, can be removed, cotton cultivation in East Africa will never be undertaken on any considerable scale.

First among the difficulties the commissioner places labor, on account of the inability of the natives and their disinclination for work. The total area devoted to cotton growing under European supervision can scarcely exceed a few thousand acres. The commissioner's opinion is that the only solution of the difficulty is indentured labor from India or China.

Prices of middling upland cotton in New Orleans, monthly, 1890–1904.

[In cents per pound.]

Year.	January.		February.		March.		April.		May.		June.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1890	$9\frac{5}{8}$	$10\frac{11}{16}$	$10\frac{3}{8}$	$10\frac{11}{16}$	$10\frac{11}{16}$	11	11	$11\frac{11}{16}$	$11\frac{9}{16}$	$11\frac{7}{8}$	$11\frac{7}{16}$	$11\frac{7}{8}$
1891	$8\frac{15}{16}$	$9\frac{5}{16}$	$8\frac{3}{4}$	$9\frac{1}{16}$	$8\frac{5}{8}$	$8\frac{3}{4}$	$8\frac{5}{16}$	$8\frac{11}{16}$	$8\frac{5}{16}$	$8\frac{3}{8}$	$7\frac{7}{8}$	$8\frac{1}{4}$
1892	$6\frac{13}{16}$	$7\frac{3}{16}$	$6\frac{1}{2}$	$6\frac{7}{8}$	$6\frac{1}{4}$	$6\frac{1}{2}$	$6\frac{3}{8}$	7	7	$7\frac{3}{16}$	$7\frac{1}{16}$	$7\frac{1}{2}$
1893	$9\frac{1}{4}$	$9\frac{5}{8}$	$8\frac{13}{16}$	$9\frac{1}{4}$	$8\frac{5}{16}$	9	$7\frac{7}{16}$	$8\frac{3}{16}$	$7\frac{1}{4}$	$7\frac{5}{8}$	$7\frac{5}{16}$	$7\frac{7}{8}$
1894	$7\frac{5}{16}$	$7\frac{3}{4}$	$7\frac{1}{16}$	$7\frac{7}{16}$	$7\frac{1}{8}$	$7\frac{5}{16}$	7	$7\frac{5}{16}$	$6\frac{13}{16}$	$7\frac{1}{16}$	$6\frac{7}{8}$	$7\frac{1}{8}$
1895	5	$5\frac{3}{16}$	5	$5\frac{3}{16}$	$5\frac{1}{16}$	$5\frac{7}{8}$	$5\frac{3}{4}$	$6\frac{3}{8}$	$6\frac{3}{16}$	7	$6\frac{5}{8}$	7
1896	$7\frac{13}{16}$	8	$7\frac{1}{2}$	8	$7\frac{3}{8}$	$7\frac{13}{16}$	$7\frac{5}{8}$	$7\frac{3}{4}$	$7\frac{3}{8}$	$7\frac{3}{4}$	$6\frac{13}{16}$	$7\frac{3}{8}$
1897	$6\frac{7}{8}$	7	$6\frac{11}{16}$	$7\frac{3}{16}$	$6\frac{15}{16}$	$7\frac{3}{16}$	$6\frac{15}{16}$	$7\frac{9}{16}$	$7\frac{5}{16}$	$7\frac{9}{16}$	$7\frac{3}{8}$	$7\frac{5}{8}$
1898	$5\frac{3}{16}$	$5\frac{3}{8}$	$5\frac{1}{4}$	$5\frac{11}{16}$	$5\frac{7}{16}$	$5\frac{3}{4}$	$5\frac{9}{16}$	$5\frac{3}{4}$	$5\frac{11}{16}$	$6\frac{1}{16}$	$5\frac{7}{8}$	$6\frac{1}{16}$
1899	$5\frac{3}{16}$	$5\frac{3}{4}$	$5\frac{3}{4}$	6	$5\frac{11}{16}$	$6\frac{1}{16}$	$5\frac{5}{8}$	$5\frac{3}{4}$	$5\frac{11}{16}$	$5\frac{7}{8}$	$5\frac{1}{2}$	$5\frac{3}{4}$
1900	$7\frac{1}{4}$	$7\frac{3}{4}$	$7\frac{7}{8}$	9	9	$9\frac{7}{16}$	$9\frac{1}{8}$	$9\frac{1}{2}$	$8\frac{13}{16}$	$9\frac{1}{2}$	$8\frac{13}{16}$	$9\frac{13}{16}$
1901	$9\frac{5}{16}$	$9\frac{11}{16}$	$9\frac{1}{16}$	$9\frac{5}{16}$	$7\frac{15}{16}$	$9\frac{1}{16}$	8	$8\frac{5}{16}$	$7\frac{9}{16}$	8	$7\frac{3}{4}$	$8\frac{7}{16}$
1902	$7\frac{3}{4}$	8	$7\frac{13}{16}$	$8\frac{3}{16}$	$8\frac{1}{4}$	$8\frac{5}{8}$	$8\frac{9}{16}$	$9\frac{3}{4}$	$9\frac{1}{8}$	$9\frac{3}{4}$	$8\frac{15}{16}$	$9\frac{5}{16}$
1903	$8\frac{7}{16}$	$8\frac{7}{8}$	$8\frac{7}{8}$	$9\frac{7}{8}$	$9\frac{9}{16}$	$9\frac{7}{8}$	$9\frac{3}{4}$	$10\frac{3}{16}$	$10\frac{3}{16}$	$11\frac{11}{16}$	$11\frac{11}{16}$	$13\frac{5}{8}$
1904	13	$15\frac{15}{16}$	$13\frac{1}{4}$	$16\frac{7}{16}$	$13\frac{3}{4}$	16	$13\frac{7}{8}$	$15\frac{5}{16}$	$12\frac{5}{8}$	$13\frac{7}{8}$	$10\frac{11}{16}$	$12\frac{3}{8}$

Year.	July.		August.		September.		October.		November.		December.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1890	$11\frac{7}{16}$	$11\frac{3}{4}$	$10\frac{3}{8}$	$11\frac{3}{4}$	$9\frac{3}{4}$	$10\frac{1}{4}$	$9\frac{11}{16}$	$10\frac{1}{16}$	$9\frac{1}{16}$	$9\frac{9}{16}$	$8\frac{13}{16}$	$9\frac{1}{8}$
1891	$7\frac{3}{4}$	$7\frac{15}{16}$	$7\frac{5}{8}$	8	8	$8\frac{1}{2}$	$7\frac{15}{16}$	$8\frac{3}{8}$	$7\frac{3}{8}$	$7\frac{7}{8}$	7	$7\frac{1}{2}$
1892	7	$7\frac{3}{16}$	$6\frac{15}{16}$	$7\frac{3}{16}$	$6\frac{15}{16}$	$7\frac{7}{16}$	$7\frac{7}{16}$	$7\frac{13}{16}$	$7\frac{11}{16}$	$9\frac{7}{8}$	$9\frac{5}{16}$	$9\frac{11}{16}$
1893	$7\frac{7}{16}$	$7\frac{3}{4}$	$6\frac{13}{16}$	$7\frac{5}{8}$	$7\frac{5}{16}$	$8\frac{3}{16}$	$7\frac{5}{8}$	$8\frac{1}{8}$	$7\frac{7}{16}$	$7\frac{3}{4}$	$7\frac{1}{8}$	$7\frac{9}{16}$
1894	$6\frac{5}{8}$	$6\frac{7}{8}$	$6\frac{7}{16}$	$6\frac{5}{8}$	$5\frac{11}{16}$	$6\frac{1}{2}$	$5\frac{3}{16}$	$5\frac{3}{4}$	$4\frac{7}{8}$	$5\frac{1}{2}$	$5\frac{1}{16}$	$5\frac{5}{16}$
1895	$6\frac{1}{2}$	$6\frac{3}{4}$	$6\frac{9}{16}$	$7\frac{11}{16}$	$7\frac{9}{16}$	$8\frac{3}{4}$	$8\frac{5}{16}$	$9\frac{3}{16}$	$8\frac{1}{16}$	$8\frac{5}{8}$	$7\frac{1}{4}$	$8\frac{3}{16}$
1896	$6\frac{1}{2}$	$6\frac{13}{16}$	$6\frac{13}{16}$	8	$7\frac{5}{8}$	$8\frac{1}{8}$	$7\frac{1}{8}$	$7\frac{5}{8}$	$7\frac{3}{16}$	$7\frac{1}{2}$	$6\frac{11}{16}$	$7\frac{3}{8}$
1897	$7\frac{11}{16}$	$7\frac{13}{16}$	$7\frac{1}{16}$	$7\frac{11}{16}$	$6\frac{1}{16}$	$7\frac{1}{16}$	$5\frac{1}{2}$	$6\frac{1}{8}$	$5\frac{1}{4}$	$5\frac{1}{2}$	$5\frac{1}{4}$	$5\frac{3}{8}$
1898	$5\frac{5}{8}$	$5\frac{7}{8}$	$5\frac{3}{8}$	$5\frac{11}{16}$	$4\frac{7}{8}$	$5\frac{3}{8}$	$4\frac{13}{16}$	5	$4\frac{3}{4}$	$5\frac{1}{16}$	5	$5\frac{1}{4}$
1899	$5\frac{5}{8}$	$5\frac{3}{4}$	$5\frac{3}{4}$	$5\frac{15}{16}$	$5\frac{3}{4}$	$6\frac{1}{2}$	$6\frac{3}{4}$	$6\frac{15}{16}$	$6\frac{7}{8}$	$7\frac{7}{16}$	$7\frac{3}{16}$	$7\frac{1}{2}$
1900	$9\frac{7}{8}$	$10\frac{1}{4}$	$9\frac{3}{8}$	$10\frac{1}{4}$	$9\frac{3}{8}$	$11\frac{1}{8}$	$8\frac{13}{16}$	$10\frac{5}{16}$	9	$9\frac{7}{8}$	$9\frac{1}{4}$	$9\frac{13}{16}$
1901	$8\frac{1}{8}$	$8\frac{7}{16}$	8	$8\frac{15}{16}$	$7\frac{15}{16}$	$8\frac{5}{8}$	$7\frac{7}{16}$	$8\frac{5}{16}$	$7\frac{1}{4}$	$7\frac{7}{16}$	$7\frac{3}{4}$	$8\frac{1}{16}$
1902	$8\frac{5}{8}$	$9\frac{1}{16}$	$8\frac{3}{8}$	$8\frac{5}{8}$	$8\frac{3}{16}$	$8\frac{5}{8}$	8	$8\frac{1}{2}$	$7\frac{5}{8}$	8	$7\frac{15}{16}$	$8\frac{3}{8}$
1903	$12\frac{5}{8}$	$13\frac{5}{8}$	$12\frac{1}{2}$	$13\frac{1}{4}$	$9\frac{3}{4}$	$12\frac{1}{2}$	$9\frac{1}{8}$	$10\frac{1}{4}$	10	$11\frac{3}{16}$	$11\frac{1}{2}$	$13\frac{5}{8}$
1904	$10\frac{1}{2}$	$11\frac{1}{8}$	$10\frac{1}{4}$	$11\frac{3}{8}$	10	$11\frac{3}{16}$	$9\frac{1}{2}$	$10\frac{3}{16}$	$8\frac{7}{8}$	$9\frac{3}{4}$	$6\frac{1}{2}$	$8\frac{9}{16}$

Compressed cotton by rail, average freight rates, in cents, per 100 pounds.

Year.	From New Orleans to—a				From Memphis to—		Year.	From New Orleans to—a				From Memphis to—	
	Boston.	New York.	Philadelphia.	Baltimore.	New York.	Boston.		Boston.	New York.	Philadelphia.	Baltimore.	New York.	Boston.
1881	58	53	54	54	66	71	1893	55	50	50	50	47	52
1882	53	48	51	51	61	66	1894	51	50	50	50	50.5	55.5
1883	60	55	53	52	72	77	1895	53	48	48	48	50.5	55.5
1884	60	55	53	52	54	59	1896	55	50	50	50	50.5	55.5
1885	60	55	53	52	56	58	1897	55	50	50	50	50	55
1886	52	47	45	44	53	58	1898	55	50	50	50	47	52
1887	50	45	43	42	53	58	1899	52	47	47	47	48	53
1888	50	45	43	42	47	52	1900	55	50	50	50	50.5	55.5
1889	52	47	45	44	50.5	55	1901	55	50	50	50	50.5	55.5
1890	55	50	50	50	50.5	55	1902	55	50	50	50	50.5	55.5
1891	55	50	50	50	50.5	55	1903	55	50	50	50	50.5	55.5
1892	55	50	50	50	50.5	55	1904	55	50	50	50	50.5	50.5

a These rates are mainly used for basing purposes.

Closing prices middling upland cotton per pound, in leading cities of the United States, 1899–1904.

Date.	New York.		New Orleans.		Memphis.		Galveston.		Savannah.		Charleston.		Wilmington.		Norfolk.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1899.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	5 7/8	6 7/16	5 3/16	5 3/4	5 3/8	5 3/4	5 7/16	6 1/16	5 1/16	5 3/4	5 1/8	5 3/4	5 5/8	5 7/8	5 5/8	6
February	6 5/16	6 5/8	5 11/16	6	5 11/16	6 1/8	6	6 3/8	5 5/8	5 15/16	5 11/16	5 15/16	5 7/8	6	6	6 1/4
March	6 3/16	6 9/16	5 11/16	6 1/8	5 7/8	6 1/8	5 15/16	6 1/4	5 11/16	5 7/8	5 5/8	5 15/16	6	6	6	6 1/8
April	6 1/8	6 5/16	5 5/8	5 3/4	5 3/4	5 7/8	5 7/8	5 15/16	5 5/8	5 11/16	5 1/2	5 5/8	5 7/8	6	5 7/8	6
May	6 1/8	6 1/4	5 11/16	5 7/8	5 3/4	5 3/4	5 7/8	5 15/16	5 5/8	5 5/8	5 1/8	5 9/16	5 7/8	5 7/8	5 7/8	6
June	6 1/16	6 5/16	5 1/8	5 3/4	5 5/8	5 13/16	5 3/4	5 15/16	5 5/8	5 5/8	6 9/16	6 5/8	5 7/8	5 7/8	5 7/8	6 1/8
July	6 1/8	6 1/4	5 5/8	5 3/4	5 5/8	5 3/4	5 7/8	5 7/8	5 5/8	5 5/8	....	....	5 7/8	5 7/8	5 7/8	6
August	6 1/8	6 1/8	5 3/4	5 15/16	5 3/4	5 15/16	5 7/8	6 1/8	5 1/2	5 7/8	5 1/2	5 11/16	5 7/8	5 7/8	5 15/16	6 1/8
September	6 1/4	6 7/8	5 3/4	6 1/8	5 7/8	6 3/4	6 1/16	6 5/8	5 5/8	6 1/8	5 1/2	6 5/8	5 7/8	6 1/8	6	6 7/8
October	7 3/16	7 3/8	6 1/8	6 15/16	6 3/4	7 1/8	6 15/16	7 1/8	6 5/8	6 7/8	6 5/8	7	6 1/8	7 1/4	7 1/16	7 3/16
November	7 3/8	7 13/16	6 7/8	7 7/16	7	7 1/8	7 1/16	7 1/8	6 7/8	7 1/4	6 7/8	7 3/8	7 1/8	7 1/2	7 1/16	7 1/2
December	7 1/8	7 3/4	7 3/16	7 1/8	7 1/4	7 7/16	7 1/4	7 7/16	7 1/8	7 5/16	7 3/16	7 3/8	7	7 1/4	7 5/16	7 1/8
1900.																
January	7 1/4	8	7 1/4	7 3/4	7 3/8	7 11/16	7 1/4	7 11/16	7 5/16	7 5/8	7 1/4	7 5/8	7 1/4	7 1/2	7 7/16	7 7/8
February	8 7/8	9 5/16	7 7/8	8 7/8	7 11/16	8 3/4	7 3/4	8 13/16	7 11/16	8 15/16	7 5/8	8 3/4	7 1/2	8 3/4	7 7/8	9 1/8
March	9 7/16	9 7/8	9	9 7/16	8 7/8	9 7/16	9 1/8	9 5/8	9 1/16	9 1/2	9	9 1/2	9	9 1/2	9 1/4	9 7/8
April	9 9/16	9 7/8	9 1/8	9 1/8	9 1/4	9 3/8	9 1/4	9 7/16	9 3/8	9 7/16	9 1/4	9 3/8	9 1/4	9 1/2	9 1/2	9 5/8
May	9	9 7/8	8 13/16	9 1/8	8 3/4	9 7/16	8 7/8	9 7/16	9	9 7/16	9 5/16	9 3/8	9 1/4	9 1/4	9 1/4	9 5/8
June	8 13/16	10	8 13/16	9 3/16	8 5/8	9 5/8	8 1/2	9 3/8	8 3/4	9 1/4	....	....	....	....	8 3/4	9 5/8
July	9 13/16	10 1/4	9 7/8	10 1/4	9 5/8	10	9 3/8	9 1/2	9 5/16	9 7/8	9 1/2	9 5/8	....	....	9 3/4	10 1/16
August	9 1/8	10 1/4	9 1/8	10 1/4	9 1/8	9 3/4	8 7/8	9 9/16	9	9 3/4	8 5/8	9 1/2	....	....	9 1/4	10
September	9 5/8	11	9 1/8	11 1/8	9 5/16	11	9 1/4	10	9 1/16	10 3/4	8 7/8	10 3/4	9	10 3/4	9 3/8	11
October	9 7/16	11	8 13/16	10 1/4	8 7/8	10 1/4	8 13/16	10	8 13/16	10 1/16	8 3/4	10	9	10 1/4	9	10 5/16
November	9 9/16	10 1/4	9	9 7/8	8 15/16	10	9	9 3/4	8 15/16	9 3/4	9	9 11/16	9	9 5/8	9	9 13/16
December	9 3/4	10 5/16	9 1/4	9 13/16	9 3/8	9 13/16	9 1/4	9 11/16	9 1/16	9 11/16	9	9 5/8	9 1/4	9 5/8	9 1/4	9 3/4
1901.																
January	9 7/8	12	9 5/16	9 11/16	9	9 5/8	9 3/8	9 11/16	9 3/8	9 5/8	9 1/4	9 5/8	9 1/4	9 1/2	9 3/8	9 11/16
February	9 1/16	10	9 1/16	9 5/16	9 1/16	9 7/16	9 1/8	9 7/16	9	9 3/8	9	9 7/8	9	9 1/2	9 1/8	9 7/16
March	8 1/8	9 15/16	7 15/16	9 1/16	8	9 1/8	8	9 1/8	7 7/8	9	7 3/4	9	7 7/8	9	8	9 1/4
April	8 1/4	8 9/16	8 1/16	8 5/16	8	8 1/4	8 1/8	8 3/8	7 15/16	8 1/8	7 7/8	8	7 1/2	7 7/8	8 1/16	8 1/4
May	8 1/16	8 5/16	7 9/16	8	7 9/16	8	7 5/8	8 1/4	7 7/16	8 1/16	7 1/2	8	7 3/4	7 7/8	7 5/8	8 1/16
June	8 1/4	8 15/16	7 3/4	8 3/8	7 5/8	8 5/16	7 13/16	8 7/16	7 1/2	8 1/8	7 1/2	8 3/4	7 3/4	7 3/4	7 3/4	8 7/16
July	8 1/8	8 7/8	8 1/8	8 7/16	8	8 5/16	8 1/8	8 1/2	8	8 1/4	8 1/8	8 1/4	7 3/4	8 1/4	7 3/4	8 1/2
August	8	8 5/8	8	8 15/16	8	8 5/8	8 1/16	8 15/16	7 5/8	8 3/8	7 3/4	8 1/4	8	8 1/4	7 13/16	8 5/8
September	8 3/16	8 5/8	7 15/16	8 5/8	7 13/16	8 5/8	7 15/16	8 15/16	7 5/8	8 3/8	7 5/8	8 3/8	8	8 1/4	8	8 5/8
October	7	8 9/16	7 7/16	8 5/16	7 1/2	8 5/8	7 5/8	8 3/8	7 3/16	8	7 3/16	8 1/8	7 5/8	8 3/8	7 3/8	8 3/16
November	7 13/16	8	7 1/2	7 7/16	7 1/8	7 5/8	7 3/8	7 5/8	7 1/8	7 5/16	7 1/8	7 3/8	7 1/8	7 3/8	7 1/4	7 1/2
December	8	8 3/4	7 3/8	8 7/16	7 5/16	8	7 1/2	8 1/8	7 1/4	7 15/16	7 11/16	8	7 1/2	7 7/8	7 1/2	8 1/16

1902.																
January	8 3/16	8 9/16	7 3/4	8	7	7 15/16	7 7/8	8	7 3/4	7 7/8	7 3/16	7 7/8	7 3/4	7 7/8	7 13/16	8
February	8 1/4	8 13/16	7 13/16	8 3/16	7 13/16	8 1/4	7 15/16	8 5/16	7 13/16	8 5/16	7 7/8	8 5/16	7 7/8	8 1/4	7 15/16	8 1/2
March	8 7/8	9 3/16	8 1/4	8 5/8	8 1/4	8 5/8	8 7/16	8 5/8	8 5/16	8 5/8	8 1/4	8 5/8	8 1/4	8 5/8	8 1/2	8 13/16
April	9	9 7/8	8 9/16	9 3/4	8 1/2	9 1/2	8 5/8	9 5/8	8 9/16	9 9/16	8 3/16	9 3/8	8 5/8	9 3/8	8 3/4	9 3/4
May	9 3/8	9 3/4	9 1/8	9 3/4	9	9 1/2	9 3/16	9 5/8	9 3/16	9 1/2	9 1/4	9 3/8	9	9 1/2	9 3/16	9 3/4
June	9 1/4	9 7/16	8 15/16	9 5/16	8 13/16	9 1/16	8 15/16	9 1/4	9	9 3/16	8 3/4	8 3/4	9	9 1/8	9 1/8	9 1/4
July	8 15/16	9 3/8	8 5/8	9 1/16	8 13/16	9	8 3/4	8 15/16	8 3/4	8 7/8	8 5/8	8 5/8	8 3/4	9	9	9 1/8
August	8 7/8	9	8 5/16	8 5/8	8 1/2	8 13/16	8 7/16	8 3/4	8 1/8	8 3/4	8 3/16	8 1/4	8 1/2	8 3/4	8 3/4	9 1/16
September	8 7/8	9 1/8	8 3/16	8 5/8	8 1/4	8 1/2	8 1/4	8 5/8	8 1/8	8 7/16	8 1/16	8 3/8	8 3/8	8 1/2	8 1/2	9
October	8 9/16	8 15/16	8	8 1/2	7 15/16	8 7/16	8 3/16	8 9/16	7 7/8	8 1/4	7 7/8	8 1/4	8 1/8	8 3/8	8 1/8	8 9/16
November	8 5/16	8 5/8	7 5/8	8	7 5/8	8	7 3/4	8 3/16	7 9/16	7 15/16	7 9/16	8	7 3/4	8 1/8	7 3/4	8 3/16
December	8 1/2	8 7/8	7 15/16	8 3/8	8	8 5/16	8 1/8	8 1/2	7 7/8	8 1/4	7 7/8	8 1/4	7 3/4	8 1/8	8 1/16	8 1/2
1903.																
January	8.85	9.05	8 7/16	8 7/8	8 1/2	8 3/4	8 5/8	8 15/16	8 3/8	8 3/4	8 1/4	8 5/8	8 1/4	8 1/2	8 5/8	9
February	9.00	10.25	8 7/8	9 7/8	8 3/4	9 7/8	8 15/16	10 1/16	8 3/4	9 7/8	8 5/8	9 3/4	8 1/2	9 3/4	9	10
March	9.90	10.45	9 9/16	9 7/8	9 11/16	9 15/16	9 7/8	10 1/16	9 5/8	9 7/8	9 1/2	9 3/4	9 1/2	9 3/4	9 3/4	10
April	9.90	10.75	9 3/4	10 3/16	9 3/4	10	9 7/8	10 1/8	9 5/8	10	9 1/2	10	9 1/2	9 3/4	10	10 1/8
May	10.75	12.15	10 3/16	11 1/16	10	11 3/8	10 1/8	11 1/2	10	11 1/4	10	11	10	10 1/2	10 3/8	11 3/8
June	11.50	13.35	11 11/16	13 5/8	11 3/8	13 5/16	11 7/16	12 3/4	11 1/4	12 1/2	....	11	....	10 1/2	11 3/8	13
July	11.60	13.50	12 3/8	13 5/8	12 7/16	13 5/16	12	12 3/4	12 1/4	13 1/8	....	....	....	....	12	13
August	12.75	12.75	12 1/2	13 1/4	12 7/16	12 15/16	12	12 1/8	12 1/8	13 1/8	12 1/4	12 1/4	....	....	12 1/2	12 1/2
September	11.25	13.00	9 3/4	12 1/2	9 3/4	12 9/16	10	12 1/2	9 7/16	12 1/2	9 1/2	11 7/8	9 1/2	11 1/4	9 3/4	12 1/2
October	9.50	10.60	9 1/2	10 1/2	9 1/2	10 1/8	9 5/16	10 3/16	9 7/16	10 1/4	9	10	9	10 1/8	9 1/4	10 3/16
November	10.50	11.65	10	11 3/16	10 1/16	11 1/8	10 1/8	11 3/16	10 1/8	11 1/8	10	10 7/8	10	11	10 1/4	11 3/8
December	11.95	14.10	11 1/2	13 5/8	11 1/4	13 1/2	11 7/16	13 3/8	11 5/8	13 3/8	11	13 1/2	11	12 3/4	11 3/4	13 3/4
1904.																
January	13.10	16.75	13	15 15/16	13	15 3/8	12 3/4	15 5/16	12 5/8	15 7/8	12 1/2	15 3/4	12 3/4	15	13	16
February	13.50	17.25	13 1/4	16 7/16	13 1/4	16 1/2	13 1/2	16	13 1/4	16 1/4	14	16	13	15 1/2	13	16 1/2
March	14.00	16.65	14	16	14	15 13/16	14	15 15/16	14 1/2	15 3/4	14 1/2	15 3/4	14	15 3/4	14	16 1/4
April	13.75	15.45	13 7/8	15 5/16	13 7/8	15 1/8	14	15 3/16	13 3/4	14 3/4	14 1/2	15 5/8	....	....	14	15 1/4
May	12.75	13.90	12 5/8	13 3/16	12 1/2	13 7/8	12 5/8	13 13/16	12 7/8	13 3/4	....	....	....	....	13	14
June	10.85	12.85	10 3/4	12 1/8	10 1/2	12	10 1/2	12 1/2	10 3/4	12 3/4	....	....	....	....	10 3/4	12 1/8
July	10.60	11.25	10 1/2	11 1/16	10 3/8	11	10 1/2	10 13/16	10 3/4	11 1/8	....	....	....	....	10 5/8	11 1/4
August	10.45	11.65	10 1/4	11 3/16	10 1/8	11	10 1/2	11 1/8	10 3/8	11	....	....	....	....	10 3/8	11
September	10.70	11.30	10	11 3/16	10 1/4	11	10 1/4	11 1/8	9 15/16	11 1/8	10	10 3/16	10 5/16	10 5/16	10	11
October	9.90	10.65	9 1/2	10 3/16	9 1/2	10 3/16	9 5/8	10 1/16	9 1/2	9 15/16	9 1/4	9 13/16	....	....	9 1/2	10 3/16
November	9.30	10.25	8 7/8	9 11/16	8 7/8	9 11/16	8 15/16	9 13/16	8 3/4	9 11/16	9	9 9/16	9	9 5/8	9	9 13/16
December	6.85	9.00	6 1/2	8 9/16	6 3/4	8 5/8	6 5/8	8 9/16	6 1/2	8 1/2	6 1/2	8 1/4	....	....	6 3/4	8 5/8

TOBACCO.

Acreage, production, and value of tobacco in the United States in 1904, by States.

States.	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Average value per acre, Dec. 1.	Farm value, Dec. 1.
	Acres.	*Pounds.*	*Pounds.*	*Cents.*	*Dollars.*	*Dollars.*
New Hampshire	119	1,610	191,590	15.0	241.50	28,738
Vermont	174	1,685	293,190	15.0	252.75	43,978
Massachusetts	4,444	1,690	7,510,360	18.6	314.34	1,396,927
Connecticut	12,705	1,685	21,407,925	22.6	380.81	4,838,191
New York	5,492	1,145	6,288,340	10.0	114.50	628,834
Pennsylvania	14,457	1,289	18,635,073	8.9	114.72	1,658,521
Maryland	32,067	621	19,913,607	6.5	40.36	1,294,384
Virginia	133,086	725	96,487,350	7.4	53.65	7,140,064
North Carolina	143,968	685	98,618,080	8.6	58.91	8,481,155
South Carolina	11,643	703	8,185,029	8.2	57.65	671,172
Georgia	1,868	650	1,214,200	20.6	133.90	250,125
Florida	4,434	815	3,613,710	31.5	256.73	1,138,319
Alabama	585	379	221,715	15.5	58.75	34,366
Mississippi	170	408	69,360	15.6	63.65	10,820
Louisiana	89	438	38,982	21.5	94.17	8,381
Texas	469	600	281,400	19.5	117.00	54,873
Arkansas	1,234	565	697,210	12.0	67.80	83,665
Tennessee	47,703	730	34,823,190	5.8	42.34	2,019,745
West Virginia	4,087	710	2,901,770	8.5	60.35	246,650
Kentucky	277,409	827	229,417,243	6.4	52.93	14,682,704
Ohio	59,827	849	50,793,123	8.0	67.92	4,063,450
Michigan	278	675	187,650	6.5	43.87	12,197
Indiana	6,244	691	4,314,604	8.5	58.73	366,741
Illinois	1,155	670	773,850	5.4	36.18	41,788
Wisconsin	40,931	1,282	52,473,542	7.8	100.00	4,092,936
Missouri	1,771	626	1,108,646	8.5	53.21	94,235
United States	806,409	819.0	660,460,739	8.1	66.20	53,382,959

Tobacco crops of 1900 and 1901.

States.	1900.					1901.				
	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Farm value, Dec. 1.	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Farm value, Dec. 1.
	Acres.	*Lbs.*	*Pounds.*	*Cents.*	*Dollars.*	*Acres.*	*Lbs.*	*Pounds.*	*Cents.*	*Dollars.*
N. H	111	1,666	184,926	15	27,739	125	1,500	187,500	15	28,125
Vt	200	1,800	360,000	12	43,200	212	1,722	365,000	10	36,500
Mass	4,041	1,823	7,367,363	15	1,141,194	4,284	1,810	7,752,200	12	964,216
Conn	10,948	1,684	18,435,765	15	2,833,041	11,782	1,586	18,682,319	15	2,756,221
N. Y	8,527	1,185	10,101,350	8	844,897	8,835	1,134	10,019,750	7	716,594
Pa	24,147	1,524	36,802,670	6	2,259,897	18,771	1,495	28,070,700	6	1,712,642
Md	43,995	527	23,182,736	6	1,314,948	44,081	597	26,315,655	6	1,675,676
Va	170,700	618	105,543,960	6	6,550,995	168,800	635	107,196,529	8	8,130,765
N. C	193,329	618	119,504,625	7	8,096,164	189,020	560	105,807,677	9	9,714,243
S. C	26,567	873	23,203,003	7	1,590,648	27,259	768	20,946,705	7	1,551,519
Ga	2,066	495	1,023,336	15	148,431	1,990	494	982,691	18	176,972
Fla	2,220	546	1,211,066	26	309,814	2,610	544	1,420,705	27	382,859
Ala	771	282	217,665	27	58,126	729	266	194,167	19	36,404
Miss	190	623	118,327	18	21,712	208	576	119,848	18	22,148
La	112	265	29,730	23	6,873	103	323	33,295	28	9,181
Tex	611	348	212,860	18	38,790	302	363	109,715	16	17,795
Ark	1,580	407	643,594	12	75,105	1,327	344	456,574	13	58,658
Tenn	65,405	657	42,971,283	6	2,403,517	66,478	717	47,659,810	6	2,860,129
W. Va	4,819	592	2,852,263	7	209,184	4,723	589	2,781,912	8	215,874
Ky	367,262	810	297,584,134	6	17,245,872	374,644	867	324,809,420	6	18,644,931
Ohio	65,503	891	58,370,304	7	3,795,869	62,357	873	54,466,263	7	3,974,205
Mich	98	600	58,800	9	5,345	100	655	65,500	7	4,585
Ind	9,279	773	7,174,722	6	440,472	8,299	788	6,541,416	5	354,143
Ill	1,563	509	796,177	7	53,980	1,324	426	563,723	7	39,825
Wis	38,651	1,400	54,126,366	7	3,857,720	38,738	1,354	52,441,051	8	4,054,830
Mo	3,732	608	2,268,316	13	287,599	2,098	459	963,248	15	144,068
U. S	1,046,427	778	814,345,341	6.6	53,661,132	1,039,199	788	818,953,373	7.1	58,283,108

HOPS.

Wholesale prices of hops per pound in leading cities of the United States, 1900–1904.

Date.	New York.		Cincinnati.		Chicago.	
	Choice State.		Choice.		Pacific coast, common to choice.	
	Low.	High.	Low.	High.	Low.	High.
1900.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	12½	13½	13	13	9	10
February	12½	13½	12½	12½	9	10
March	12½	13½	12½	12½	9	10
April	12½	13½	12½	12½	9	10
May	12½	14	10	10	10	11
June	13	14	10	10	6½	10
July	13	14	10	10	6½	11
August	13	15	10	10	6¾	11
September	13	15	16½	16½	8	11
October	17	21	16½	16½	17	18
November	20	21	17½	17½	17	18
December	18	21	18	18	17	18
1901.						
January	17	20	17¾	17¾	17	18
February	....	....	17¾	17¾	17	18
March	18	20	17¾	17¾	18	19
April	18	20	17¾	17¾	18	19
May	17½	20	17⅞	17⅞	18	19
June	17½	18	17¾	17¾	17	18
July	16	18	17⅞	17⅞	17	18
August	14	17	17⅜	17⅜	15	16
September	13	16	17¼	17¼	14	15
October	14	15½	14	14	12½	14
November	14	15½	13¾	13¾	12½	14
December	14	15½	14	14	13	15
1902.						
January	14	16	14½	14½	12½	14
February	14½	18	15½	15½	15	16
March	17	19	17½	17½	13	16½
April	18	20	18½	18½	15	18
May	19	22	19½	19½	15	20
June	20½	24	21½	21½	15	20
July	22	26	23	23	20	22
August	24½	28	25	25	22	25
September	26	28	26½	26½	25	26
October	32	37	29½	29½	26	29
November	35	38	30	30	26	30
December	35	38	30	30	29	31
1903.					Good to choice.	
January	35	37	29	29	27	31
February	33	37	29	29	27	31
March	30	35	29½	29½	25	29
April	23	30	25	25	20	25
May	23	24	25	25	20	24
June	22½	24	24	24	22	24
July	20½	23½	24	24	19	22
August	20½	26	24	24	21	25
September	24½	30	25	25	26	28
October	30	33	26	26	20	27
November	30	32	26	26	24	26
December	30	35	27	27	24	27
1904.						
January	34	37	28	31	28½	34
February	36	38	31	34	30	35
March	34	38	30	32	32	34
April	33	36	30	32	30	34
May	33	35	29	31	30	35
June	32	35	29	30	30	32
July	32	34	29	30	30	31
August	32	35	29	29	30	34
September	33	37	29	31	28½	31
October	35	41	31	36	30	35½
November	36	41	36	37	32	37
December	35	38	34	36	33	37

FLAXSEED.

Flax crop of countries named, 1901–1903.

Country.	Seed.			Fiber.		
	1901.	1902.	1903.	1901.	1902.	1903.
	Bushels.	*Bushels.*	*Bushels.*	*Pounds.*	*Pounds.*	*Pounds.*
United States	a 25,000,000	29,285,000	27,301,000	....	....	....
Manitoba	275,000	582,000	582,000	....	....	....
Mexico	165,000	152,000	150,000	....	....	....
Argentina	15,352,000	14,371,000	30,076,000	....	....	....
Total America	40,792,000	44,390,000	58,109,000	....	....	....
Ireland	....	....	....	29,736,000	25,182,000	19,327,000
Sweden	60,000	a 60,000	a 60,000	b 3,162,000	b 3,162,000	b 3,162,000
Netherlands	389,000	384,000	362,000	18,387,000	19,234,000	18,497,000
Belgium	280,000	266,000	272,000	25,538,000	24,280,000	24,790,000
France	611,000	450,000	a 500,000	54,683,000	39,624,000	a 47,000,000
Italy c	....	....	....	41,917,000	41,917,000	41,917,000
Austria	1,131,000	1,034,000	1,120,000	122,267,000	113,508,000	103,848,000
Hungary	162,000	173,000	a 170,000	13,461,000	18,533,000	a 15,000,000
Croatia-Slavonia	23,000	26,000	a 24,000	8,684,000	8,803,000	a 8,000,000
Total Austria-Hungary	1,316,000	1,233,000	1,314,000	144,412,000	140,844,000	126,848,000
Roumania	554,000	1,005,000	2,064,000	1,433,000	4,484,000	12,267,000
Bulgaria d	23,000	23,000	23,000	2,116,000	2,116,000	2,116,000
Servia	e 11,000	e 11,000	e 11,000	832,000	2,847,000	1,861,000
Russia f	15,227,000	20,173,000	17,997,000	728,044,000	1,165,098,000	1,003,641,000
Total Europe	18,471,000	23,605,000	22,603,000	1,050,260,000	1,468,788,000	1,301,426,000
British India	13,041,000	14,077,000	19,263,000	....	....	....
Algeria a	10,000	10,000	10,000	....	....	....

RECAPITULATION.

America	40,792,000	44,390,000	58,109,000	....	....	....
Europe	18,471,000	23,605,000	22,603,000	1,050,260,000	1,468,788,000	1,301,426,000
British India	13,041,000	14,077,000	19,263,000	....	....	....
Algeria	10,000	10,000	10,000	....	....	....
Total	72,314,000	82,082,000	99,985,000	1,050,260,000	1,468,788,000	1,301,426,000

a Commercial estimate. b Average, 1898–1900. c Average, 1892–1895. d Average, 1897–1899. e 1897 figures. f Includes Poland.

Acreage, production, and value of flaxseed in the United States in 1904, by States.

States.	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Average value per acre, Dec. 1.	Farm value, Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*	*Dollars.*
Wisconsin	25,442	12.2	310,392	112	13.66	347,639
Minnesota	537,356	10.8	5,803,445	101	10.91	5,861,479
Iowa	65,037	10.5	682,888	98	10.29	669,230
Missouri	24,342	6.0	146,052	97	5.82	141,670
Kansas	95,055	6.0	570,330	93	5.58	530,407
Nebraska	12,327	7.0	86,289	100	7.00	86,289
South Dakota	207,256	10.0	2,072,560	98	9.80	2,031,109
North Dakota	1,233,792	10.6	13,078,195	99	10.49	12,947,413
Montana	9,334	8.0	74,672	95	7.60	70,938
Idaho	23,729	10.7	253,900	85	9.09	215,815
Oregon	2,231	12.0	26,772	122	14.64	32,662
California	1,022	12.5	12,775	106	13.25	13,542
Oklahoma	20,402	12.0	244,824	99	11.88	242,376
Indian Territory	6,240	6.0	37,440	102	6.12	38,189
United States	2,263,565	10.3	23,400,534	99.3	10.26	23,228,758

Monthly average prices of flaxseed in Chicago.[a]

[Cents per bushel.]

Month.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
January	112¾	137¾	140¾	91¼	75⅝	124	115¼	152	166½	165½	119	108
February	120	138½	141¼	90¾	75¾	126	117	159	168	168½	117	113¾
March	119¼	134½	140	88	78¾	120⅝	119½	162½	157½	168½	111½	112
April	114½	126	140½	90¼	75¾	124	118½	170½	161	172½	109	107¼
May	107¾	131½	147¾	86	77⅞	131	109¾	178	169¼	168½	112¾	104½
June	109	138¾	149¾	79¼	77½	113	105¼	177	179	165	106	104
July	107	128¼	133	73	83	96¾	100¾	165	184½	155	96¼	113
August	94⅝	125¾	107¾	68⅜	103⅞	89	108¼	141	162½	146	99	121
September	101¾	136	97⅜	70⅞	103¼	89¾	112¾	150½	152	135¾	101½	118½
October	102	145	94¼	74¼	99¼	98⅛	123¼	166¾	149½	121½	96¼	112½
November	108¾	146½	92⅛	75⅛	106¼	101¾	133⅜	172	146¼	118	95	113¾
December	128¼	145½	93	75½	113¼	108⅜	145	162¼	149¾	119½	96½	118½
Yearly average	110½	136	123⅛	80¼	89⅛	110¼	117⅜	163 1/24	162⅛	150⅜	105	112¼

[a] This table exhibits average cash prices for the past twelve years. The monthly prices are the means between the lowest and highest prices for each month, and the yearly prices are the averages of the monthly averages.

Wholesale prices of flaxseed per bushel in leading cities of the United States, 1900–1904.

Date.	St. Louis.		Cincinnati.		Chicago.		Milwaukee.		Duluth.	
	Prime.				No. 1.					
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1900.										
January	$1.45	$1.50	$1.00	$1.00	$1.48	$1.56	$1.42	$1.56	$1.40	$1.50
February	1.52	1.58	1.00	1.00	1.58	1.60	1.50	1.60	1.51	1.51¼
March	1.57	1.62	1.00	1.00	1.60	1.65	1.45	1.65	1.56	1.64
April	1.62	1.70	1.00	1.20	1.65	1.75	1.61½	1.73	1.64	1.73
May	1.62	1.65	1.20	1.20	1.76	1.80	1.65	1.80	1.70	1.80
June	1.55	1.58	1.20	1.30	1.74	1.80	1.72½	1.80	1.80	1.80
July	1.35	1.60	1.20	1.30	1.50	1.80	1.42	1.80	1.40	1.80
August	1.25	1.45	1.20	1.20	1.32	1.50	1.30	1.42	1.28½	1.44
September	1.42	1.56½	1.20	1.30	1.41½	1.59½	1.42½	1.75	1.43	1.59
October	1.46	1.75	1.30	1.30	1.47½	1.86	1.48½	1.86	1.48½	1.87
November	1.50	1.78	1.30	1.30	1.60	1.84	1.60	1.82	1.59½	1.85⅛
December	1.62	1.62	1.30	1.45	1.53½	1.71	1.54	1.68	1.60	1.80⅛
1901.										
January	1.50	1.72	1.30	1.45	1.56	1.77	1.45	1.76	1.57	1.73
February	1.58	1.72	1.30	1.50	1.60	1.76	1.60	1.75	1.59	1.72½
March	1.50	1.60	1.35	1.50	1.52	1.63	1.45	1.63½	1.53½	1.61
April	1.49	1.52	1.20	1.50	1.52	1.70	1.45	1.70	1.54½	1.76⅛
May	1.56	1.67	1.20	1.20	1.64½	1.74	1.55	1.75	1.67	1.78
June	1.67	1.68	1.20	1.30	1.70	1.88	1.35	1.88	1.65	1.88
July	1.50	1.65	1.30	1.30	1.79	1.90	1.75	1.88	1.75	1.88
August	1.37	1.65	1.30	1.40	1.40	1.85	1.48	1.83	1.44	1.75
September	1.37	1.38	1.25	1.35	1.38	1.66	1.40	1.65	1.39	1.62
October	1.38	1.48	1.25	1.25	1.41	1.58	1.44	1.63	1.38	1.54
November	....	....	1.25	1.30	1.40	1.52½	1.40	1.52½	1.34¼	1.49¼
December	....	....	1.30	1.30	1.38½	1.61	1.39	1.61	1.34½	1.55½
1902.										
January	....	....	1.30	1.40	1.58	1.73	1.61	1.73	1.56½	1.71½
February	....	....	1.30	1.40	1.63	1.74	1.66	1.73	1.65	1.72
March	....	....	1.30	1.40	1.63	1.74	1.68	1.74	1.65	1.74
April	....	....	1.30	1.40	1.65	1.80	1.74	1.80	1.72	1.78
May	1.50	1.65	1.30	1.40	1.58	1.79	1.76	1.79	1 .70	1.77
June	1.50	1.50	1.25	1.35	1.54	1.76	1.73	1.76	1.60	1.76⅛
July	1.41	1.50	1.30	1.40	1.36	1.74	1.43	1.74	1.35	1.66
August	1.32½	1.45	1.25	1.30	1.37	1.55	1.40	1.55	1.35	1.50
September	1.22	1.38	1.25	1.25	1.25½	1.46	1.25	1.45	1.24½	1.47
October	1.12	1.25	1.25	1.25	1.15	1.28	1.19	1.28	1.15¼	1.27¾
November	1.11	1.14½	1.25	1.25	1.13	1.23	1.18	1.23	1.1 5½	1.20
December	1.11	1.14	1.25	1.25	1.14	1.25	1.20	1.25	1.16	1.21⅛
1903.										
January	1.12	1.17	1.30	1.30	1.14	1.24	1.21	1.24	1.14⅛	1.20
February	1.10	1.14	1.30	1.30	1.12	1.22	1.16	1.22	1.11¾	1.16⅞
March	1.05	1.12	1.30	1.30	1.06	1.17	1.00	1.17	1.07¾	1.13⅛
April	1.05	1.08	1.10	1.30	1.06	1.12	1.09	1.11½	1.08¾	1.11
May	1.07	1.17	1.00	1.10	1.08	1.17½	1.11	1.17½	1.10¼	1.16
June	.95	1.08	1.00	1.00	.98	1.14	1.01½	1.14	.99½	1.13
July	.91	.96	1.00	1.00	.90	1.02½	.95½	1.02½	.95	1.00⅞
August	.91	1.00	1.00	1.00	.93	1.05	.97	1.05	.96¾	1.01⅛

Wholesale prices of flaxseed per bushel in leading cities of the United States, 1900–1904—Continued.

Date.	St. Louis.		Cincinnati.		Chicago.		Milwaukee.		Duluth.	
	Prime.				No. 1.					
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1903.										
September	$0.92	$1.00	$1.00	$1.00	$0.94	$1.09	$0.99	$1.09	$0.99	$1.09
October	.86	.93	1.00	1.00	.89	1.03½	.94½	1.04	.92	1.02¾
November	.86	.89	1.00	1.00	.90	1.00	.94	1.00	.93½	1.00
December	.87½	.90½	1.00	1.00	.90½	1.02½	.97½	1.01½	.95¾	1.00
1904.										
January	.92½	1.07	1.00	1.00	.97	1.19	1.03½	1.19	1.01½	1.17
February	1.06	1.08½	1.00	1.00	1.09	1.18½	1.16	1.18½	1.13½	1.17
March	1.04	1.06	1.00	1.00	1.07½	1.16½	1.13	1.16½	1.14	1.15½
April	.96	1.06	1.00	1.00	.98½	1.16	1.06	1.14½	1.05½	1.15⅝
May	.96	.98½	1.00	1.00	.99½	1.09½	1.06½	1.10	1.05⅞	1.08
June	.97	.98	1.00	1.00	1.00	1.08	1.06½	1.08½	1.07¾	1.09¾
July	.98	1.15½	1.00	1.00	1.02	1.24	1.07½	1.24	1.09¼	1.24
August	1.13½	1.18	....	....	1.15½	1.26½	1.23	1.26½	1.23	1.26½
September	1.08	1.18½	....	....	1.09	1.28	1.24½	1.28	1.16½	1.28
October	1.06	1.10	....	....	1.07	1.18	1.14½	1.18½	1.13½	1.17¼
November	1.07	1.11	....	....	1.08	1.19½	1.15½	1.19½	1.14	1.18⅝
December	1.12	1.16	....	....	1.11	1.26	1.19	1.26	1.18	1.25¾

RICE.

Acreage, production, and value of rice in the United States in 1904, by States.

States.	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Average value per acre, Dec. 1.	Farm value, Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*	*Dollars.*
North Carolina	1,800	32.4	58,320	79	25.60	46,073
South Carolina	33,300	25.0	832,500	67	16.75	557,775
Georgia	9,000	26.0	234,000	66	17.16	154,440
Florida	3,706	28.0	103,768	96	26.88	99,617
Alabama	1,956	34.8	68,069	99	34.45	67,388
Mississippi	1,544	25.7	39,681	99	25.44	39,284
Louisiana	376,500	30.4	11,445,600	65	19.76	7,439,640
Texas	234,200	35.5	8,314,100	66	23.43	5,487,306
United States	662,006	31.9	21,096,038	65.8	20.98	13,891,523

Wholesale prices of rice per pound, 1900–1904.

Date.	New York.		Cincinnati.		Memphis.		New Orleans.	
	Domestic (good).		Prime.		Not classed by name.			
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1900.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	4¾	4¾	5½	6	3	7	3¾	6⅜
February	4¾	4¾	5½	6	3	7	3¾	6⅜
March	4¾	4⅝	5½	6	3½	7	3¾	6⅜
April	4⅝	4⅝	5½	6	3¾	6½	3¾	6¼
May	4⅝	4⅝	5½	6	3	7	3¾	6¼
June	4¾	4¾	5½	6	3	7½	4½	6⅝
July	4¾	4¾	5½	6	3	7½	4½	6⅝
August	4¾	4¾	5½	6	3	7½	4¼	6⅝
September	4¾	4⅞	5½	6	3½	7½	4¼	6¼
October	4¾	4⅞	5½	6	4	7½	4¼	6
November	4¾	5	5½	6	4	7	4¼	6
December	5	5	5½	6	3½	7½	4¼	6
1901.								
January	5	5	5½	6	....	....	....	....
February	4⅞	5	5½	6½	....	....	....	....
March	4⅞	4⅞	5½	6½	....	....	....	....
April	4⅞	4⅞	5½	6½	....	....	....	....

Wholesale prices of rice per pound, 1900–1904—Continued.

Date.	New York. Domestic (good).		Cincinnati. Prime.		Memphis. Not classed by name.		New Orleans.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1901.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
May	4⅞	4⅞	5½	6½	......	......	......	......
June	4⅞	4⅞	5½	6½	......	......	......	......
July	4¾	5	5½	6½	......	......	......	......
August	5	5	5½	6½	......	......	......	......
September	5	5	5½	6½	......	......	......	......
October	5	5	5½	6½	......	......	......	......
November	4⅞	4⅞	5½	6½	......	......	......	......
December	4¾	4¾	5½	6½	......	......	......	......
1902.								
January	4¾	4¾	5½	6½	......	......	......	......
February	4¾	4¾	5½	6½	......	......	......	......
March	4¾	4¾	5½	6½	......	......	......	......
April	4¾	4¾	5½	6½	......	......	......	......
May	4¾	5	5½	6½	......	......	......	......
June	4⅞	5¼	5½	6½	......	......	......	......
July	4⅞	5¼	5½	6½	......	......	......	......
August	4⅞	4⅞	5½	6½	......	......	......	......
September	4⅞	4⅞	5½	6½	......	......	......	......
October	4⅞	4⅞	5¼	5¾	......	......	......	......
November	4⅞	4⅞	5¼	5¾	......	......	......	......
December	5	5	5¼	5¾	......	......	......	......
1903.								
January	4⅞	5	4⅜	5¼	......	......	......	......
February	5	5	4⅜	5¼	......	......	......	......
March	5⅛	5¼	4⅜	5¼	......	......	......	......
April	5¼	5¼	4⅜	5¼	......	......	......	......
May	5¼	5¼	4⅜	5¼	......	......	......	......
June	5¼	5¼	4⅜	5¼	......	......	......	......
July	5¼	5¼	4⅜	5¼	......	......	......	......
August	5⅛	5¼	4⅜	5¼	......	......	......	......
September	4⅞	5⅛	4⅜	5¼	......	......	......	......
October	4½	4⅞	4⅜	5½	......	......	......	......
November	4¼	4½	4⅝	5½	......	......	......	......
December	4¼	4¼	4⅝	5½	......	......	......	......
1904.								
January	4¼	4¼	4¾	5¼	......	......	......	......
February	4	4	4¾	5¼	......	......	......	......
March	4	4	4½	5	......	......	......	......
April	4	4	4¼	4¾	......	......	......	......
May	3¾	4	4¼	4¾	......	......	......	......
June	3⅝	3¾	4¼	4¾	......	......	......	......
July	3⅝	3⅝	3¾	4¼	......	......	......	......
August	3⅜	3⅝	3¾	4¼	......	......	......	......
September	3⅜	3⅜	3¾	4¼	......	......	......	......
October	3⅜	3⅜	3¾	4¼	......	......	......	......
November	3⅜	3⅜	3¾	4¼	......	......	......	......
December	3⅜	3⅜	3¾	4¼	......	......	......	......

SUGAR.

Sugar production of countries named, 1900–1901 to 1904–1905.[a]

Countries.	1900–1901.	1901–1902.	1902–1903.	1903–1904.	1904–1905.
CANE SUGAR.					
United States:	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Louisiana	270,338	321,676	300,000	215,000	330,000
Porto Rico	80,000	85,000	85,000	130,000	155,000
Hawaiian Islands	321,462	317,509	391,062	328,103	312,000
Cuba	635,856	850,181	998,878	1,040,228	1,175,000
British West Indies:					
Trinidad, exports	52,673	52,673	42,679	44,058	28,000
Barbados, exports	55,360	46,315	38,179	58,081	42,000
Jamaica	17,059	15,843	18,772	14,255	18,000
Antigua and St. Kitts	21,579	19,000	18,000	19,000	19,000

[a] Cane-sugar production and United States beet-sugar production from Willett & Gray (in tons of 2,240 pounds); European beet-sugar production from Licht (in metric tons of 2,204.622 pounds).

Sugar production of countries named, 1900–1901 to 1904–1905—Continued.

Countries.	1900–1901.	1901–1902.	1902–1903.	1903–1904.	1904–1905.
CANE SUGAR—continued.					
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*
French West Indies:					
Martinique, exports	39,750	34,942	29,035	23,925	25,000
Guadeloupe	39,000	41,000	38,000	36,000	36,000
Danish West Indies:					
St. Croix	13,000	13,000	13,000	13,000	11,000
Haiti and Santo Domingo	45,000	45,000	45,000	45,000	45,000
Lesser Antilles (not named above)	15,000	15,000	12,000	13,000	13,000
Mexico	95,000	103,110	112,679	107,547	115,000
Central America:					
Guatemala	9,000	8,000	8,000	7,640	8,000
San Salvador	5,000	5,000	6,000	6,300	7,000
Nicaragua	3,500	4,500	4,500	4,235	4,500
Costa Rica	4,000	3,000	3,000	3,275	3,500
South America:					
British Guiana (Demarara), exports	84,559	123,967	121,570	113,282	100,000
Dutch Guiana (Surinam)	13,000	12,750	13,046	13,000	13,000
Venezuela	3,000	3,000	3,000	3,000	3,000
Peru, exports	135,000	138,000	140,000	140,000	140,000
Argentina	114,252	135,000	130,000	142,895	126,550
Brazil	308,011	349,088	187,500	197,000	190,000
Total America	2,380,399	2,742,554	2,758,900	2,717,824	2,919,550
Asia:					
British India, exports	15,000	15,000	15,000	15,000	30,000
Java	709,928	767,130	842,812	885,561	1,008,900
Philippine Islands, exports	55,400	78,637	90,000	80,000	120,000
Total Asia	780,328	860,767	947,812	980,561	1,158,900
Australia and Polynesia:					
Queensland	92,554	120,858	76,626	91,723	150,804
New South Wales	19,000	18,000	21,000	21,500	20,000
Fiji Islands, exports	33,000	31,000	35,500	50,000	56,000
Total Australia and Polynesia	144,554	169,858	133,126	163,223	226,804
Africa:					
Egypt	94,880	98,000	87,500	90,000	90,000
Mauritius	175,267	147,828	150,349	215,000	140,000
Reunion	42,631	33,098	39,624	41,117	30,000
Total Africa	312,778	278,926	277,473	346,117	260,000
Europe:					
Spain	28,000	28,000	28,000	28,000	28,000
Total cane-sugar production	3,646,059	4,080,105	4,145,311	4,235,725	4,593,254
BEET SUGAR.					
Europe:					
Germany	1,984,187	2,305,013	1,762,461	1,927,681	1,575,000
Austria	1,094,043	1,301,548	1,057,692	1,167,959	893,000
France	1,113,893	1,123,545	833,210	804,308	625,000
Russia	918,838	1,098,983	1,256,311	1,206,907	940,000
Belgium	333,119	324,960	224,090	203,446	173,000
Holland	178,081	203,193	102,411	123,551	135,000
Other countries	367,919	393,236	325,082	441,116	340,000
Total Europe	5,990,080	6,750,478	5,561,257	5,874,968	4,681,000
United States:					
California	25,451	62,723	71,120	60,608	41,540
Nebraska	4,406	6,660	9,430	8,669	13,355
Utah	7,630	12,748	16,987	20,670	25,274
New York	3,669	4,049	2,799	4,479	3,214
Michigan	24,533	46,692	48,848	57,064	46,659
Minnesota	1,186	2,455	3,054	3,125	3,304
Oregon	888	1,250	2,025	1,250	2,348
Illinois	1,150	....	....	....	....
Colorado	5,982	19,977	34,623	39,566	49,606
Washington	625	857	1,641	2,213	2,679
Ohio	1,339	3,126	1,473	2,009	4,304
Wisconsin	....	2,589	3,463	4,911	9,598
Idaho	....	....	....	3,571	7,841
Total United States	76,859	163,126	195,463	208,135	209,722
Total beet sugar	6,066,939	6,913,604	5,756,720	6,083,103	4,890,722
Total cane and beet sugar	9,712,998	10,993,709	9,902,031	10,318,828	9,483,976

Quantity and value of sugar imported into the United States from the principal sources of supply during each fiscal year, from 1900 to 1904, inclusive.

QUANTITY.

Countries from which imported.	Annual average, 1900–1904.	Year ended June 30— 1900.	1901.	1902.	1903.	1904.	Per cent in 1904.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Cuba	1,601,026,740	705,456,230	1,099,404,363	984,216,925	2,396,497,779	2,819,558,402	76.19
Dutch East Indies	781,805,678	1,162,202,854	777,986,990	636,710,315	891,758,090	440,370,139	11.90
Santo Domingo	109,951,865	122,206,692	107,193,244	111,580,425	112,988,775	95,790,189	2.59
British Guiana	151,988,319	149,715,600	183,331,202	181,237,759	172,361,345	73,295,689	1.98
British West Indies	177,242,479	200,479,351	232,989,234	194,969,474	191,924,220	65,850,114	1.78
Philippine Islands	29,190,364	49,490,542	4,693,333	11,424,000	18,773,333	61,570,614	1.66
Peru	88,971,565	75,155,975	129,534,403	102,647,624	88,848,044	48,671,777	1.32
Egypt	56,306,840	74,015,702	63,389,981	59,557,384	62,348,580	22,222,552	.60
Danish West Indies	23,792,625	21,664,980	19,217,052	16,037,682	41,205,950	20,837,461	.56
Brazil	164,230,500	89,684,600	293,327,013	349,794,460	74,159,889	14,186,540	.38
Dutch Guiana	13,381,419	13,265,520	14,063,215	16,861,587	15,722,225	6,994,546	.19
Germany	324,581,686	590,984,996	716,824,596	217,872,627	91,745,860	5,480,349	.15
Chinese Empire	4,054,526	4,606,743	7,914,450	2,397,107	752,285	4,602,045	.12
Canada	3,006,858	878,778	1,399,269	2,436,647	6,285,045	4,034,551	.11
Austria-Hungary	82,701,466	96,130,457	161,174,865	111,818,771	40,857,724	3,525,512	.10
Mexico	1,450,705	1,892,029	1,358,503	338,368	2,414,373	1,250,252	.03
United Kingdom	7,578,624	9,375,569	17,272,407	11,125,336	119,739	70	......
Netherlands	6,929,806	153,860	25,327,230	8,967,942	200,000	....	......
Russia, European	6,947,198	866,788	32,770,130	1,099,072	....	....	......
Belgium	17,155,646	15,198,903	70,099,670	479,655	....	....	......
British East Indies	1,977,040	9,840,433	....	44,766	....	....	......
British Africa:							
East Africa	8,638,049	36,502,673	6,687,573	....	....	....	......
Other			....	....	....	....	......
Hawaii	a 504,713,105	504,713,105	(b)	(b)	(b)	(b)	......
Porto Rico	a 72,558,181	72,558,181	(b)	(b)	(b)	(b)	......
Other countries	9,983,739	11,045,969	9,047,117	10,297,949	7,144,850	12,382,811	.34
Total	3,788,347,993	4,018,086,530	3,975,005,840	3,031,915,875	4,216,108,106	3,700,623,613	100.00

VALUE.

Countries from which imported.	Annual average, 1900–1904.	1900.	1901.	1902.	1903.	1904.	Per cent in 1904.
	Dollars.	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	
Cuba	32,416,845	18,243,644	26,373,690	18,205,411	42,714,079	56,547,403	78.63
Dutch East Indies	14,824,584	24,170,081	16,965,511	12,325,518	13,251,816	7,409,996	10.30
Santo Domingo	2,448,736	3,365,061	2,959,067	2,061,977	2,107,428	1,750,145	2.43
British Guiana	3,343,289	3,779,398	4,803,479	3,372,104	3,333,032	1,428,433	1.99
British West Indies	3,423,477	4,603,409	5,058,565	3,226,575	3,136,172	1,092,663	1.52
Philippine Islands	474,448	925,335	103,857	188,159	270,729	884,160	1.23
Peru	1,687,079	1,444,784	2,702,180	1,910,311	1,517,514	860,605	1.20
Egypt	1,255,638	1,843,077	1,653,695	1,351,038	1,014,831	415,551	.58
Danish West Indies	497,046	544,985	460,694	377,581	705,587	396,384	.55
Brazil	2,665,195	1,693,588	5,347,503	4,908,735	1,176,049	200,102	.28
Canada	155,983	94,809	108,137	123,441	256,894	196,633	.27
Dutch Guiana	308,778	375,633	382,876	349,242	301,235	134,902	.19
Chinese Empire	111,350	125,986	229,795	63,429	13,640	123,900	.17
Germany	6,597,699	12,346,734	15,556,811	3,597,234	1,370,305	117,410	.16
Austria-Hungary	1,781,332	2,132,790	3,727,094	2,288,547	677,836	80,393	.11
Mexico	45,184	41,082	35,994	9,408	103,439	35,998	.05
United Kingdom	171,119	228,447	431,959	192,945	2,241	4	......
Netherlands	192,085	4,151	718,422	232,963	4,888	....	......
Russia, European	176,317	22,993	829,401	29,193	....	....	......
Belgium	418,006	353,699	1,724,724	11,607	....	....	......
British East Indies	40,989	203,610	....	1,333	....	....	......
British Africa:							
East Africa	131,332	576,585	80,076	....	....	....	......
Other			....	....	....	....	......
Hawaii	a 20,392,150	20,392,150	(b)	(b)	(b)	(b)	......
Porto Rico	a 2,449,616	2,449,616	(b)	(b)	(b)	(b)	......
Other countries	226,054	289,327	234,270	234,346	131,258	241,071	.34
Total	77,960,919	100,250,974	90,487,800	55,061,097	72,088,973	71,915,753	100.00

a Statistics for 1900 only. b No longer in the returns of foreign trade.

Production of beet and cane sugar in the United States.[a]

Years.	Beet.	Cane (Louisiana).	Total.[b]	Years.	Beet.	Cane (Louisiana).	Total.[b]
	Tons.[c]	*Tons.*[c]	*Tons.*[c]		*Tons.*[c]	*Tons.*[c]	*Tons.*[c]
1883–84	535	128,443	128,978	1894–95	20,092	317,334	337,426
1884–85	953	94,376	95,329	1895–96	29,220	237,721	266,941
1885–86	600	127,958	128,558	1896–97	37,536	282,009	319,545
1886–87	800	80,859	81,659	1897–98	40,398	310,313	350,711
1887–88	255	157,971	158,226	1898–99	32,471	248,658	281,129
1888–89	1,861	144,878	146,739	1899–1900	72,972	142,485	215,457
1889–90	2,203	130,413	132,616	1900–1901	76,859	270,338	347,197
1890–91	3,459	215,844	219,303	1901–2	163,126	321,676	484,802
1891–92	5,356	160,937	166,293	1902–3	195,463	329,227	524,690
1892–93	12,018	217,525	229,543	1903–4	208,135	215,000	423,135
1893–94	19,950	265,836	285,786	1904–5	209,722	330,000	539,722

[a] Data as to beet sugar are obtained from the following sources: For 1899–1900, from the Twelfth Census; for 1897–98, from a special report of the Department of Agriculture; and for other years from Willett and Gray. Data as to cane sugar are from the following sources: For 1889–90, 1898–99, and 1899–1900, from the Eleventh and Twelfth censuses; for 1903–4 and 1904–5, from Willett and Gray; for other years, from Bouchereau's Annual Louisiana Sugar Reports (the figures for 1892–93 being taken from his revised statement).

[b] These figures do not include cane sugar produced outside of Louisiana; in 1889–90 such sugar amounted to 4,089 tons, and 1899–1900 to 1,510 tons.

[c] Tons of 2,240 pounds.

BEANS.

Wholesale prices of beans per bushel in leading cities of the United States, 1900–1904.

Date.	New York.		Cincinnati.		Chicago.		Detroit.		San Francisco.	
	Pea.		Pea.		Pea.		Pea.		Small white, per cwt.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1900.										
January	$1.86½	$2.06¼	$2.25	$2.40	$1.70	$2.12½	$1.78	$2.05	$2.85	$3.00
February	1.98	2.13	2.40	2.40	1.90	2.10	1.98	2.05	3.15	3.25
March	1.90	2.11	2.20	2.40	1.90	2.10	2.00	2.00	3.15	3.35
April	1.90	2.15	2.10	2.15	1.90	2.20	2.00	2.08	3.40	3.50
May	1.85⅝	2.25	2.00	2.55	1.90	2.18	2.08	2.10	3.40	3.50
June	1.80	2.25	2.45	2.55	1.90	2.16	2.10	2.10	3.25	3.40
July	1.80	2.21¼	2.45	2.55	1.90	2.15	2.10	2.10	3.40	3.50
August	1.75¼	2.08	2.45	2.55	1.90	2.15	Not quoted.		3.50	3.65
September	1.79	2.07⅛	2.10	2.55	1.75	2.25	1.55	1.70	3.75	4.00
October	1.95	2.10	2.10	2.25	1.65	1.90	1.70	1.84	3.60	3.75
November	1.91	2.05	2.10	2.25	1.68	1.87	1.70	1.90	3.90	4.00
December	2.14	2.17	2.10	2.25	1.70	2.10	1.90	2.08	4.00	4.50
1901.										
January	2.25	2.35	2.50	2.55	1.75	2.20	1.85	2.15	3.60	4.70
February	2.20	2.27½	2.50	2.50	1.80	2.10	1.94	2.00	3.75	4.90
March	2.00	2.25	2.40	2.50	.90	2.02	1.80	1.88	3.60	4.90
April	2.00	2.12½	2.40	2.40	1.25	1.97	1.80	1.90	3.75	4.95
May	1.97½	2.10	2.40	2.40	1.25	1.90	1.74	1.80	3.70	4.95
June	1.95	2.12½	2.40	2.40	1.50	2.05	1.75	1.95	3.60	4.90
July	2.07½	2.25	2.40	2.40	1.60	2.50	1.85	2.40	3.40	5.00
August	2.30	2.77½	2.40	3.00	2.10	2.80	2.40	2.40	2.00	4.25
September	2.25	2.75	3.00	3.00	1.65	2.80	2.40	2.40	2.05	4.25
October	2.05	2.30	2.60	3.00	1.55	2.00	1.68	1.92	2.00	5.00
November	1.95	2.05	2.60	2.75	1.50	1.92	1.66	1.85	2.50	3.50
December	1.95	2.00	2.60	2.75	1.69	1.87	1.72	1.81	2.80	3.25
1902.									Lima.	
January	1.75	2.00	2.60	2.70	1.40	1.83	1.60	1.79	4.40	4.65
February	1.65	1.80	2.60	2.70	1.40	1.75	1.53	1.62	4.40	4.60
March	1.60	1.75	2.60	2.70	1.20	1.65	1.28	1.51	4.35	4.40
April	1.50	1.82½	2.30	2.70	.85	1.80	1.28	1.62	3.30	3.60
May	1.75	1.85	2.30	2.60	1.50	1.85	1.56	1.75	3.60	3.80
June	1.60	1.70	2.30	2.60	1.50	1.70	1.48	1.60	3.60	3.85
July	1.65	2.00	2.30	2.50	1.60	1.90	1.60	1.90	3.60	3.85
August	1.95	2.05	2.30	2.50	1.60	1.96	1.63	1.90	3.80	4.10
September	1.90	1.95	2.30	2.50	1.60	1.90	1.75	1.85	3.70	3.90
October	1.92½	2.45	2.25	2.50	1.78	2.49	1.70	1.98	4.10	4.35
November	2.30	2.45	2.20	2.40	2.15	2.30	1.66	1.88	4.20	4.50
December	2.25	2.37½	2.25	2.40	2.15	2.30	1.74	1.81	4.25	4.55

Wholesale prices of beans per bushel in leading cities of the United States, 1900–1904—Continued.

Date.	New York. Pea. Low.	New York. Pea. High.	Cincinnati. Pea. Low.	Cincinnati. Pea. High.	Chicago. Pea. Low.	Chicago. Pea. High.	Detroit. Pea. Low.	Detroit. Pea. High.	San Francisco. Small white, per cwt. Low.	San Francisco. Small white, per cwt. High.
1903.			Navy.						Small white.	
January	$2.35	$2.37½	$2.40	$2.50	$1.25	$2.40	$2.24	$2.35	$2.90	$3.40
February	2.32½	2.40	2.25	2.50	1.20	2.30	2.10	2.23	2.90	3.35
March	2.20	2.30	2.30	2.40	1.25	2.25	2.10	2.16	3.00	3.30
April	2.00	2.25	2.15	2.40	.90	2.20	1.88	2.10	3.00	3.30
May	2.15	2.35	2.15	2.25	.90	2.30	2.07	2.35	2.90	3.25
June	2.30	2.35	2.15	2.25	1.25	2.35	2.20	2.25	3.00	3.25
July	2.27½	2.32½	2.15	2.25	1.20	2.23	2.10	2.21	3.00	3.25
August	2.15	2.27½	2.15	2.25	1.15	2.25	1.91	1.96	3.00	3.20
September	2.25	2.40	2.15	2.25	1.50	2.50	2.10	2.35	2.85	3.25
October	2.15	2.40	2.15	2.25	1.05	2.25	1.90	2.28	3.00	3.25
November	2.10	2.25	2.15	2.25	1.05	2.15	1.90	2.00	2.75	3.15
December	2.05	2.15	2.05	2.25	1.35	2.00	1.82	1.90	2.40	3.00
1904.										
January	1.97½	2.05	2.05	2.10	1.00	1.90	1.75	1.77	2.75	3.00
February	1.75	2.20	2.05	2.10	1.25	2.05	1.74	1.98	2.80	3.00
March	1.80	2.20	2.05	2.10	1.25	2.05	1.70	1.95	2.85	3.10
April	1.75	1.97½	2.05	2.10	1.00	1.85	1.70	1.80	2.90	3.15
May	1.75	2.07½	2.05	2.10	1.10	1.80	1.70	1.87	2.95	3.10
June	1.50	1.90	2.05	2.10	1.10	1.78	1.60	1.70	2.90	3.05
July	1.50	1.82½	2.05	2.10	1.10	1.70	1.60	1.61	2.75	3.00
August	1.50	1.82½	2.05	2.10	1.10	1.65	1.61	1.78	2.75	3.00
September	1.50	1.80	2.05	2.10	.90	1.65	....	....	2.75	3.10
October	1.50	1.90	2.05	2.10	.90	1.75	1.65	1.72	2.75	3.32½
November	1.50	1.82½	1.80	1.90	1.10	1.70	1.58	1.64	2.75	3.30
December	1.70	1.80	1.80	1.90	1.20	1.70	1.58	1.62	2.75	3.30

CLOVER SEED.

Wholesale prices of clover seed per 100 pounds (60 pounds to the bushel), 1900–1904.

Date.	Cincinnati. Prime (per bushel). Low.	Cincinnati. Prime (per bushel). High.	Chicago. Poor to choice. Low.	Chicago. Poor to choice. High.	Toledo. Poor to choice (per bushel). Low.	Toledo. Poor to choice (per bushel). High.	Detroit. Per bushel. Low.	Detroit. Per bushel. High.
1900.								
January	$4.00	$4.50	$5.00	$8.40	$5.57½	$5.80	$5.60	$5.75
February	4.00	4.50	5.00	8.50	5.55	5.80	5.50	5.75
March	4.00	4.65	5.00	8.50	5.20	5.67½	5.20	5.50
April	4.00	4.65	4.00	8.10	4.95	5.15	4.80	5.05
May	4.00	4.20	4.00	7.50	5.00	5.00	4.80	4.90
June	4.00	4.50	4.50	8.00	5.10	5.30	4.90	5.35
July	4.25	4.50	4.50	8.00	5.50	5.50	5.10	5.35
August	4.25	5.20	4.00	10.25	5.40	6.20	5.75	6.55
September	4.80	5.75	5.00	10.25	6.10	6.10	6.55	6.90
October	5.00	6.00	5.00	10.75	6.50	7.85	6.65	7.10
November	5.00	5.70	5.00	10.25	6.15	6.40	6.75	6.90
December	5.00	5.70	4.00	10.50	6.60	6.87½	6.70	6.80
1901.					Prime.			
January	5.50	6.25	4.00	11.00	7.10	7.35	6.90	7.30
February	5.75	6.60	5.00	11.50	6.80	7.40	6.75	7.35
March	6.00	6.40	5.00	11.15	6.55	6.75	6.50	6.80
April	5.80	6.40	5.00	11.00	6.50	6.75	6.50	6.65
May	5.80	6.00	4.00	10.75	6.30	6.57½	6.00	6.50
June	....	....	5.00	9.50	6.40	6.50	6.00	6.00
July	....	....	6.00	10.00	6.20	6.60	6.00	6.25
August	6.00	6.00	7.00	10.25	5.80	6.60	5.85	6.50
September	4.85	5.80	4.50	10.40	5.15	5.90	5.15	5.90
October	4.50	5.10	4.50	8.75	5.15	5.60	5.15	5.60
November	4.60	5.25	5.00	9.25	5.40	5.65	5.40	5.65
December	4.75	5.60	6.00	9.50	5.62½	5.90	5.65	5.90
1902.	Per 100 pounds.							
January	8.65	9.60	7.00	10.00	4.25	6.15	5.70	6.10
February	8.65	9.20	6.50	9.70	4.95	5.80	5.55	5.80
March	8.00	9.20	6.00	9.00	4.30	5.65	5.10	5.55
April	7.10	8.35	4.00	8.35	3.90	5.30	4.90	5.20
May	6.85	7.50	5.50	8.35	3.90	5.22½	5.00	5.20

Wholesale prices of clover seed per 100 pounds (60 pounds to the bushel), 1900-1904— Continued.

Date.	Cincinnati.		Chicago.		Toledo.		Detroit.	
	Prime (per bushel).		Poor to choice.		Poor to choice (per bushel).		Per bushel.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
June	$6.85	$7.30	$6.00	$8.35	$4.00	$5.25	Not quoted.	
July	6.85	7.50	6.00	8.40	4.10	5.30	Not quoted.	
August	7.10	8.35	6.00	9.10	4.20	5.60	Not quoted.	
September	7.10	8.35	7.00	9.50	4.25	5.65	$5.15	$5.90
October	7.50	8.75	7.00	11.35	4.70	7.00	5.15	5.60
November	7.50	9.20	8.00	11.15	4.75	7.10	5.35	5.65
December	8.35	9.20	8.00	10.90	5.50	6.85	5.60	5.90
1903.	Per bushel.							
January	5.25	6.50	8.50	11.90	4.40	7.42½	7.25	7.30
February	6.00	6.50	9.25	11.90	5.25	7.25	7.00	7.10
March	6.25	7.10	....	12.50	4.00	7.42½	6.95	7.40
April	6.00	6.90	5.00	12.25	3.60	7.62½	6.60	7.25
May	5.40	7.00	8.00	12.50	4.00	7.70	7.50	7.50
June	5.40	6.00	8.00	11.75	6.00	6.75	Not quoted.	
July	....	....	8.00	12.50	6.40	7.10	Not quoted.	
August	....	....	8.50	12.50	4.85	7.10	Not quoted.	
September	5.00	5.70	5.00	11.00	4.00	6.65	Not quoted.	
October	5.25	5.70	6.00	11.50	3.75	6.80	6.45	6.90
November	5.25	5.60	4.00	11.00	3.40	6.82½	6.50	6.60
December	5.25	6.00	6.00	11.25	3.05	7.05	6.80	6.95
1904.								
January	5.75	6.25	6.00	11.50	3.10	7.07½	6.75	7.00
February	5.75	6.25	6.00	11.25	4.00	7.02½	6.75	6.90
March	5.75	6.90	6.00	11.65	2.50	7.15	6.20	7.10
April	5.50	6.50	7.50	11.00	3.00	6.62½	6.20	6.55
May	4.80	5.00	6.00	10.75	3.00	6.35	6.30	6.35
June	4.80	5.00	6.00	10.75	2.50	6.25	....	....
July	4.80	5.00	7.00	11.25	3.00	6.60	6.25	6.50
August	4.80	6.50	8.00	12.75	5.70	7.60	6.50	7.50
September	6.00	6.50	9.00	12.50	3.60	7.45	7.05	7.45
October	5.50	6.75	7.00	12.25	3.00	7.52½	7.30	7.55
November	5.50	6.50	7.00	12.25	3.30	7.70	7.35	7.65
December	5.50	7.50	7.00	13.00	3.62½	7.95	7.70	7.95

TIMOTHY SEED.

Wholesale prices of timothy seed per 100 pounds (45 pounds to the bushel), 1900-1904.

Date.	Cincinnati.		Chicago.		Milwaukee.	
	Per bushel.		Per 100 pounds.		Per 100 pounds.	
	Low.	High.	Low.	High.	Low.	High.
1900.						
January	$1.03	$1.07	$2.47½	$2.55	$2.00	$2.50
February	1.03	1.12	2.40	2.55	2.00	2.50
March	1.05	1.12	2.32½	2.50	1.90	2.55
April	1.07	1.12	2.35	2.47½	1.90	2.55
May	1.07	1.12	2.40	2.55	1.90	2.60
June	1.07	1.12	2.40	3.40	2.00	3.15
July	1.15	1.40	3.00	3.40	2.65	3.25
August	1.35	1.80	3.00	4.02½	2.75	4.25
September	1.60	1.95	3.90	4.60	3.50	4.50
October	1.70	2.00	4.15	4.40	3.50	4.30
November	1.70	1.85	4.20	4.55	3.50	4.20
December	1.70	1.85	4.45	4.65	3.50	4.40
1901.						
January	1.70	2.00	4.60	4.77½	3.65	4.50
February	1.85	2.05	4.35	4.60	4.00	4.50
March	1.85	2.00	4.00	4.40	3.75	4.40
April	1.80	1.95	3.75	4.15	3.50	4.20
May	1.80	1.85	3.35	3.90	3.00	4.00
June	....	....	3.60	4.30	3.00	4 60
July	....	....	4.30	5.25	3.65	5.25
August	2.00	2.40	4.90	5.75	3.75	5.25
September	2.30	2.40	5.20	5.70	4.25	5.25
October	2.35	2.60	5.50	5.90	4.25	5.60
November	2.50	2.65	5.75	6.35	4.50	6.00
December	2.50	2.90	6.35	6.55	5.00	6.50

Wholesale prices of timothy seed per 100 pounds (45 pounds to the bushel), 1900–1904—Continued.

Date.	Cincinnati.		Chicago.		Milwaukee.	
	Per bushel.		Per 100 pounds.		Per 100 pounds.	
	Low.	High.	Low.	High.	Low.	High.
1902.	Per 100 pounds.					
January	$6.10	$6.40	$5.00	$6.55	$5.50	$6.25
February	6.10	6.40	5.00	6.60	5.50	6.25
March	6.10	6.40	5.00	7.00	5.50	6.60
April	6.40	6.60	4.50	7.10	6.00	6.75
May	....	....	5.00	7.35	5.50	6.75
June	....	....	4.50	6.35	5.00	6.25
July	....	....	4.50	5.75	4.00	5.75
August	3.90	4.40	3.25	5.75	3.75	5.00
September	3.80	4.00	2.00	4.75	2.75	4.10
October	3.30	3.65	2.00	4.20	2.50	3.75
November	3.40	3.65	2.00	4.25	3.00	3.75
December	3.40	3.65	2.00	4.25	3.00	3.75
1903.	Per bushel.					
January	1.55	1.70	2.50	4.35	3.00	3.75
February	1.55	1.70	2.50	4.35	3.00	3.75
March	1.45	1.65	2.00	3.95	2.00	3.75
April	1.35	1.50	2.00	3.70	2.00	3.25
May	1.35	1.50	2.00	3.75	2.25	2.90
June	1.35	1.60	2.00	4.00	2.35	3.35
July	....	....	1.75	3.65	2.60	3.35
August	....	....	1.75	3.40	2.50	3.25
September	1.35	1.50	2.50	3.40	2.50	3.25
October	1.25	1.50	2.00	3.17½	2.30	3.00
November	1.25	1.40	2.00	3.00	2.25	2.85
December	1.20	1.40	2.00	3.05	2.25	2.75
1904.						
January	1.20	1.35	2.00	3.25	2.25	3.15
February	1.25	1.35	2.25	3.25	2.50	3.15
March	1.25	1.35	2.00	3.25	2.00	3.15
April	1.20	1.35	2.00	3.00	2.00	2.90
May	1.20	1.30	2.00	3.05	2.25	2.90
June	1.20	1.30	2.00	3.05	2.25	2.90
July	1.20	1.30	2.00	3.25	2.00	3.00
August	1.20	1.35	2.00	3.05	2.50	3.00
September	1.15	1.35	2.00	3.00	2.25	3.00
October	1.15	1.25	1.75	2.75	2.10	2.80
November	1.15	1.30	1.75	2.70	2.10	2.65
December	1.15	1.30	1.75	2.72½	2.25	2.65

Monthly average prices per bushel of timothy seed in Chicago. [a]

Month.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
January	$4.42½	$4.25	$5.71¼	$3.68¾	$2.70	$2.73¾	$2.36¼	$2.51¼	$4.68¾	$6.40	$4.30	$3.00
February	4.46¼	4.17½	5.75	3.75	2.65	2.86¼	2.45	2.47½	4.47½	6.50	4.05	3.02½
March	4.34	4.20	5.56¼	3.35	2.67½	2.90	2.32½	2.41¼	4.20	6.70	3.65	2.95
April	4.13	4.27½	5.32½	3.25	2.85	2.81¼	2.36¼	2.41¼	3.95	7.02½	3.35	2.90
May	3.87½	4.07½	5.25	3.25	2.90	2.80	2.32½	2.47½	3.62½	6.82½	3.60	2.96¼
June	3.75	4.37½	5.37½	3.05	2.73¾	2.70	2.35	2.90	3.95	6.05	3.80	2.98¾
July	3.97½	4.92½	5.80	3.02½	2.72½	2.57½	2.45	3.20	4.77½	5.60	3.50	2.97½
August	3.52½	5.32½	4.80	2.87½	2.81¼	2.47½	2.47½	3.51¼	5.32½	4.80	3.27½	2.92½
September	3.35	5.50	3.95	2.56¼	2.75	2.41¼	2.42½	4.25	5.45	4.10	3.25	2.85
October	3.32½	5.43¾	3.50	2.55	2.66¼	2.27½	2.42½	4.27½	5.70	3.95	2.96¼	2.65
November	3.27½	5.52½	3.57½	2.56¼	2.66¼	2.22½	2.43¾	4.37½	6.05	3.92½	2.92½	2.66¼
December	3.85	5.60	3.52½	2.62½	2.68¾	2.25	2.42½	4.55	6.45	4.12½	2.95	2.71¼
Yearly average	$3.85\frac{11}{16}$	4.80½	4.84⅜	3.04½	$2.73\frac{7}{16}$	$2.58\frac{9}{16}$	2.40⅛	$3.27\frac{29}{32}$	$4.88\frac{11}{16}$	5.50	3.46¾	$2.88\frac{5}{16}$

[a] This table exhibits average cash prices for the past twelve years. The monthly prices are the means between the lowest and highest prices for each month, and the yearly prices are the averages of the monthly averages.

FARM ANIMALS AND THEIR PRODUCTS.

HORSES AND MULES.

Number and farm value of horses and mules, 1880–1905.

January 1—	Horses.		Mules.	
	Number.	Value.	Number.	Value.
1880	11,201,800	$613,296,611	1,729,500	$105,948,319
1881	11,429,626	667,954,325	1,720,731	120,096,164
1882	10,521,554	615,824,914	1,835,169	130,945,378
1883	10,838,111	765,041,308	1,871,079	148,732,390
1884	11,169,683	833,734,400	1,914,126	161,214,976
1885	11,564,572	852,282,947	1,972,569	162,497,097
1886	12,077,657	860,823,208	2,052,593	163,381,096
1887	12,496,744	901,685,755	2,117,141	167,057,538
1888	13,172,936	946,096,154	2,191,727	174,853,563
1889	13,663,294	982,194,827	2,257,574	179,444,481
1890	14,213,837	978,516,562	2,331,027	182,394,099
1891	14,056,750	941,823,222	2,296,532	178,847,370
1892	15,498,140	1,007,593,636	2,314,699	174,882,070
1893	16,206,802	992,225,185	2,331,128	164,763,751
1894	16,081,139	769,224,799	2,352,231	146,232,811
1895	15,893,318	576,730,580	2,333,108	110,927,834
1896	15,124,057	500,140,186	2,278,946	103,204,457
1897	14,364,667	452,649,396	2,215,654	92,302,090
1898	13,960,911	478,362,407	2,190,282	96,109,516
1899	13,665,307	511,074,813	2,134,213	95,963,261
1900	13,537,524	603,969,442	2,086,027	111,717,092
1901	16,744,723	885,200,168	2,864,458	183,232,209
1902	16,531,224	968,935,178	2,757,017	186,411,704
1903	16,557,373	1,030,705,959	2,728,088	197,753,327
1904	16,736,059	1,136,940,298	2,757,916	217,532,832
1905	17,057,702	1,200,310,020	2,888,710	251,840,378

Imports and exports of horses and mules, with average prices, 1892–1904.

Year ended June 30—	Imports of horses.			Exports of horses.			Exports of mules.		
	Number.	Value.	Average price.	Number.	Value.	Average price.	Number.	Value.	Average price.
1892	14,074	$2,455,868	$174.50	3,226	$611,188	$189.46	1,965	$238,591	$121.42
1893	15,451	2,388,267	154.57	2,967	718,607	242.20	1,634	210,278	128.69
1894	6,166	1,319,572	214.01	5,246	1,108,995	211.40	2,063	240,961	116.80
1895	13,098	1,055,191	80.56	13,984	2,209,298	157.99	2,515	186,452	74.14
1896	9,991	662,591	66.32	25,126	3,530,703	140.52	5,918	406,161	68.63
1897	6,998	464,808	66.42	39,532	4,769,265	120.64	7,473	545,331	72.97
1898	3,085	414,899	134.49	51,150	6,176,569	120.75	8,098	664,789	82.09
1899	3,042	551,050	181.15	45,778	5,444,342	118.93	6,755	516,908	76.52
1900	3,102	596,592	192.32	64,722	7,612,616	117.62	43,369	3,919,478	90.38
1901	3,785	985,738	260.43	82,250	8,873,845	107.89	34,405	3,210,267	93.31
1902	4,832	1,577,234	326.41	103,020	10,048,046	97.53	27,586	2,692,298	97.60
1903	4,999	1,536,296	307.32	34,007	3,152,159	92.69	4,294	521,725	121.47
1904	4,726	1,460,287	308.99	42,001	3,189,100	75.93	3,658	412,971	112.90

IMPORTS OF HORSES INTO FRANCE.

(From Annales du Commerce Extérieure, 1904.)

Imports of horses into France have risen from 17,561 head, worth 12,184,000 francs ($2,351,512) in 1902, to 19,022 head, valued at 12,928,000 francs ($2,495,104) in 1903. There were increases in the imports of horses, mares, and colts. Algeria remains the principal source of supply for stallions; geldings and mares come principally from Austria-Hungary, Belgium, and England.

While the imports have increased equine exports have decreased, namely, 19,089 head, valued at 20,331,000 francs ($3,923,883) in 1903, against 23,227 head, valued at 24,103,000 francs ($4,651,879) in 1902.

Number, average price, and farm value of horses and mules in the United States January 1, 1905, by States.

States and Territories.	Horses.			Mules.		
	Number.	Average farm price, Jan. 1.	Farm value.	Number.	Average farm price, Jan. 1.	Farm value.
Maine	136,150	$82.08	$11,175,449	....	....	....
New Hampshire	63,625	79.08	5,031,342	....	....	....
Vermont	90,894	79.74	7,248,213	....	....	....
Massachusetts	143,139	110.45	15,809,296	....	....	....
Rhode Island	15,764	90.76	1,430,699	....	....	....
Connecticut	58,002	93.26	5,409,438	....	....	....
New York	637,600	94.22	60,077,605	3,787	$102.26	$387,253
New Jersey	94,278	98.58	9,293,580	4,974	113.45	564,316
Pennsylvania	607,506	92.56	56,230,811	38,532	99.87	3,848,129
Delaware	35,089	80.48	2,823,805	5,387	98.30	529,561
Maryland	143,683	79.71	11,452,476	18,080	100.93	1,824,745
Virginia	252,506	74.80	19,635,500	42,015	93.46	3,926,864
North Carolina	164,030	87.25	14,311,389	142,217	102.92	14,636,500
South Carolina	74,731	88.45	6,610,239	106,592	110.20	11,746,672
Georgia	123,141	99.42	12,243,293	201,060	117.96	23,716,413
Florida	47,413	80.99	3,839,931	16,025	120.87	1,936,948
Alabama	147,754	71.33	10,539,723	161,599	97.52	15,758,485
Mississippi	252,226	62.98	15,886,143	219,902	95.13	20,919,089
Louisiana	183,068	52.93	9,690,587	137,574	104.51	14,377,177
Texas	1,277,768	35.46	45,308,760	391,038	60.87	23,803,473
Arkansas	253,419	56.52	14,322,391	158,505	78.67	12,469,563
Tennessee	272,326	78.61	21,408,453	163,991	93.84	15,389,200
West Virginia	169,030	74.64	12,616,713	9,888	82.00	810,790
Kentucky	395,352	71.15	28,127,471	177,030	86.20	15,260,524
Ohio	785,893	87.28	68,590,061	16,454	86.83	1,428,700
Michigan	553,495	87.71	48,545,800	2,632	68.49	180,272
Indiana	636,141	87.42	55,608,572	57,435	87.21	5,009,084
Illinois	1,232,304	85.04	104,795,162	127,570	87.17	11,120,709
Wisconsin	567,554	86.20	48,921,705	4,748	72.33	343,442
Minnesota	688,706	75.97	52,320,858	8,082	75.59	610,957
Iowa	1,144,456	74.49	85,250,746	44,096	80.05	3,529,755
Missouri	809,887	69.14	55,995,599	243,466	79.92	19,457,407
Kansas	880,627	65.92	58,052,253	107,112	75.67	8,105,476
Nebraska	795,552	62.26	49,534,566	52,844	75.11	3,969,198
South Dakota	467,258	58.59	27,375,247	6,962	68.00	473,440
North Dakota	391,705	70.06	27,443,401	7,457	83.77	624,707
Montana	236,781	38.37	9,084,698	3,424	57.17	195,754
Wyoming	101,237	29.92	3,029,508	1,481	51.05	75,608
Colorado	219,546	41.96	9,211,315	9,280	62.51	580,112
New Mexico	112,454	22.68	2,550,612	4,946	40.79	201,726
Arizona	106,605	25.50	2,718,271	3,923	47.77	187,385
Utah	104,256	39.05	4,071,521	2,064	32.20	66,461
Nevada	76,620	42.62	3,265,645	2,239	50.13	112,252
Idaho	145,195	43.44	6,307,422	1,582	56.52	89,416
Washington	225,755	63.10	14,244,307	2,435	65.97	160,625
Oregon	215,017	54.42	11,700,376	6,805	63.15	429,762
California	363,339	67.48	24,518,741	66,361	76.39	5,069,044
Oklahoma	354,976	52.68	18,701,121	62,409	73.79	4,605,362
Indian Territory	193,849	41.01	7,949,206	44,707	73.99	3,308,022
United States	17,057,702	70.37	1,200,310,020	2,888,710	87.18	251,840,378

COMPETITION IN LIVE-STOCK TRADE IN ARGENTINA.

United States Minister Beaupré at Buenos Aires, Argentina, wrote on September 20, 1904, regarding live-stock sales there that English importers, with the exception of one who had long had a monopoly of the market, were not disposed to sit by and see a portion of their business fall to the United States. They were open in their criticism, judged the animals from the British point of view, and all had influence with a wide circle of friends; but perhaps the most effective opposition came from certain native breeders who are not in favor of bringing further live stock into Argentina.

Range of prices for horses in Omaha, monthly, 1900–1904.

Date.	Drafts.		General purposes.		Southern.		Western.		Drivers.		Carriage teams.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1900.												
January	$75.00	$135.00	$55.00	$85.00	$20.00	$45.00	$10.00	$20.00	$95.00	$225.00	$200.00	$300.00
February	80.00	150.00	55.00	90.00	20.00	50.00	10.00	20.00	95.00	225.00	200.00	300.00
March	90.00	165.00	55.00	90.00	20.00	50.00	10.00	20.00	95.00	225.00	200.00	300.00
April	90.00	175.00	60.00	100.00	20.00	50.00	10.00	20.00	95.00	225.00	200.00	300.00
May	100.00	150.00	65.00	105.00	20.00	45.00	12.50	22.50	90.00	325.00	300.00	450.00
June	90.00	140.00	40.00	65.00	15.00	45.00	12.50	25.00	90.00	325.00	300.00	450.00
July	90.00	140.00	40.00	60.00	15.00	45.00	15.00	27.50	75.00	200.00	200.00	325.00
August	90.00	140.00	40.00	60.00	15.00	45.00	17.50	30.00	75.00	220.00	210.00	420.00
September	90.00	140.00	40.00	60.00	15.00	45.00	20.00	40.00	85.00	175.00	215.00	360.00
October	100.00	160.00	40.00	65.00	20.00	45.00	30.00	77.50	90.00	215.00	175.00	435.00
November	90.00	150.00	40.00	60.00	20.00	50.00	12.50	45.00	90.00	325.00	230.00	370.00
December	100.00	160.00	35.00	60.00	20.00	55.00	12.50	40.00	90.00	300.00	200.00	375.00
1901.												
January	90.00	150.00	55.00	85.00	25.00	60.00	10.00	30.00	95.00	225.00	200.00	300.00
February	95.00	160.00	55.00	90.00	25.00	60.00	10.00	30.00	95.00	225.00	200.00	300.00
March	90.00	165.00	55.00	90.00	20.00	55.00	10.00	30.00	95.00	225.00	200.00	300.00
April	90.00	200.00	60.00	100.00	20.00	50.00	10.00	35.00	95.00	225.00	200.00	400.00
May	100.00	200.00	65.00	105.00	20.00	45.00	12.50	35.00	90.00	325.00	300.00	450.00
June	90.00	150.00	40.00	80.00	20.00	45.00	12.50	40.00	90.00	325.00	300.00	450.00
July	90.00	160.00	40.00	80.00	15.00	45.00	10.00	45.00	75.00	200.00	200.00	400.00
August	90.00	160.00	40.00	80.00	15.00	45.00	5.00	40.00	75.00	220.00	210.00	420.00
September	90.00	175.00	40.00	80.00	15.00	45.00	5.00	50.00	85.00	175.00	215.00	360.00
October	100.00	175.00	40.00	80.00	20.00	45.00	10.00	60.00	90.00	215.00	175.00	435.00
November	90.00	160.00	40.00	80.00	20.00	50.00	10.00	45.00	90.00	325.00	230.00	370.00
December	100.00	160.00	45.00	85.00	20.00	55.00	12.50	40.00	90.00	300.00	200.00	375.00
1902.												
January	90.00	175.00	55.00	85.00	35.00	80.00	10.00	50.00	95.00	225.00	200.00	350.00
February	95.00	185.00	60.00	100.00	35.00	80.00	10.00	50.00	95.00	225.00	200.00	350.00
March	100.00	200.00	60.00	100.00	35.00	80.00	10.00	50.00	95.00	225.00	200.00	350.00
April	100.00	225.00	60.00	110.00	30.00	65.00	10.00	50.00	100.00	250.00	200.00	500.00
May	100.00	250.00	65.00	105.00	25.00	60.00	12.50	60.00	90.00	325.00	300.00	500.00
June	90.00	200.00	60.00	90.00	20.00	45.00	12.50	60.00	90.00	325.00	300.00	450.00
July	90.00	175.00	40.00	80.00	15.00	45.00	10.00	65.00	75.00	200.00	200.00	400.00
August	90.00	175.00	40.00	80.00	15.00	45.00	10.00	80.00	75.00	220.00	210.00	420.00
September	90.00	175.00	40.00	80.00	15.00	45.00	10.00	100.00	85.00	175.00	215.00	360.00
October	100.00	175.00	40.00	80.00	20.00	45.00	10.00	100.00	90.00	215.00	175.00	435.00
November	90.00	160.00	40.00	80.00	20.00	65.00	10.00	80.00	90.00	325.00	230.00	370.00
December	100.00	185.00	45.00	85.00	20.00	70.00	12.50	60.00	90.00	300.00	200.00	375.00
1903.												
January	90.00	175.00	50.00	80.00	35.00	70.00	10.00	50.00	95.00	225.00	200.00	350.00
February	95.00	185.00	60.00	100.00	35.00	75.00	10.00	50.00	95.00	225.00	200.00	350.00
March	100.00	200.00	60.00	110.00	35.00	70.00	10.00	50.00	100.00	230.00	200.00	400.00
April	100.00	250.00	60.00	110.00	30.00	65.00	10.00	50.00	100.00	250.00	200.00	500.00
May	110.00	250.00	65.00	105.00	20.00	55.00	12.50	60.00	100.00	350.00	250.00	550.00
June	90.00	200.00	65.00	100.00	15.00	40.00	12.50	65.00	100.00	375.00	300.00	450.00
July	90.00	175.00	50.00	80.00	15.00	45.00	10.00	65.00	75.00	275.00	200.00	400.00
August	90.00	175.00	45.00	80.00	15.00	45.00	10.00	90.00	75.00	220.00	210.00	420.00
September	90.00	175.00	40.00	80.00	15.00	45.00	10.00	100.00	95.00	200.00	215.00	360.00
October	100.00	180.00	40.00	80.00	20.00	45.00	10.00	100.00	90.00	215.00	200.00	435.00
November	90.00	160.00	45.00	85.00	20.00	60.00	10.00	80.00	100.00	325.00	225.00	370.00
December	100.00	185.00	45.00	85.00	20.00	60.00	12.50	60.00	100.00	300.00	200.00	375.00
1904.												
January	120.00	175.00	65.00	90.00	45.00	90.00	10.00	50.00	75.00	150.00	300.00	400.00
February	120.00	175.00	70.00	90.00	40.00	80.00	10.00	50.00	75.00	150.00	300.00	400.00
March	120.00	175.00	75.00	95.00	35.00	70.00	10.00	50.00	75.00	150.00	300.00	400.00
April	125.00	200.00	75.00	100.00	30.00	65.00	10.00	50.00	90.00	175.00	300.00	400.00
May	140.00	275.00	90.00	125.00	30.00	65.00	15.00	35.00	125.00	300.00	300.00	750.00
June	135.00	250.00	75.00	110.00	30.00	60.00	15.00	40.00	125.00	300.00	300.00	700.00
July	125.00	200.00	65.00	100.00	30.00	60.00	15.00	65.00	120.00	175.00	300.00	400.00
August	120.00	175.00	50.00	90.00	30.00	60.00	15.00	90.00	100.00	175.00	300.00	400.00
September	120.00	175.00	60.00	100.00	30.00	60.00	15.00	110.00	100.00	175.00	300.00	400.00
October	125.00	200.00	65.00	100.00	40.00	75.00	15.00	100.00	125.00	200.00	300.00	450.00
November	130.00	235.00	70.00	100.00	40.00	90.00	10.00	35.00	125.00	200.00	300.00	450.00
December	130.00	225.00	70.00	100.00	45.00	75.00	12.50	60.00	125.00	200.00	300.00	400.00

CATTLE AND DAIRY PRODUCTS.

Number and farm value of milch cows and other cattle, 1880 to 1905.

January 1—	Milch cows.		Other cattle.	
	Number.	Value.	Number.	Value.
1880	12,027,000	$279,899,420	21,231,000	$341,761,154
1881	12,368,653	296,277,060	20,938,710	362,861,509
1882	12,611,632	326,489,310	23,280,238	463,069,501
1883	13,125,685	396,575,405	28,046,077	611,549,109
1884	13,501,206	423,486,649	29,046,101	683,229,054
1885	13,904,722	412,903,093	29,866,573	694,382,913
1886	14,235,388	389,985,523	31,275,242	661,956,274
1887	14,522,083	378,789,589	33,511,750	663,137,926
1888	14,856,414	366,252,173	34,378,363	611,750,520
1889	15,298,625	366,226,376	35,032,417	597,236,812
1890	15,952,883	353,152,133	36,849,024	560,625,137
1891	16,019,591	346,397,900	36,875,648	544,127,908
1892	16,416,351	351,378,132	37,651,239	570,749,155
1893	16,424,087	357,299,785	35,954,196	547,882,204
1894	16,487,400	358,998,661	36,608,168	536,789,747
1895	16,504,629	362,601,729	34,364,216	482,999,129
1896	16,137,586	363,955,545	32,085,409	508,928,416
1897	15,941,727	369,239,993	30,508,408	507,929,421
1898	15,840,886	434,813,826	29,264,197	612,296,634
1899	15,990,115	474,233,925	27,994,225	637,931,135
1900	16,292,360	514,812,106	27,610,054	689,486,260
1901	16,833,657	505,093,077	45,500,213	906,644,003
1902	16,696,802	488,130,324	44,727,797	839,126,073
1903	17,105,227	516,711,914	44,659,206	824,054,902
1904	17,419,817	508,841,489	43,629,498	712,178,134
1905	17,572,464	482,272,203	43,669,443	661,571,308

Imports and exports of live cattle, with average prices, 1892 to 1904.

Year ended June 30—	Imports.			Exports.		
	Number.	Value.	Average price.	Number.	Value.	Average price.
1892	2,168	$47,466	$21.89	394,607	$35,099,095	$88.95
1893	3,293	45,682	13.87	287,094	26,032,428	90.68
1894	1,592	18,704	11.75	359,278	33,461,922	93.14
1895	149,781	765,853	5.11	331,722	30,603,796	92.26
1896	217,826	1,509,856	6.93	372,461	34,560,672	92.79
1897	328,977	2,589,857	7.87	392,190	36,357,451	92.70
1898	291,589	2,913,223	9.99	439,255	37,827,500	86.12
1899	199,752	2,320,362	11.62	389,490	30,516,833	78.35
1900	181,006	2,257,694	12.47	397,286	30,635,153	77.11
1901	146,022	1,931,433	13.23	459,218	37,566,980	81.81
1902	96,027	1,608,722	16.75	392,884	29,902,212	76.11
1903	66,175	1,161,548	17.55	402,178	29,848,936	74.22
1904	16,056	310,737	19.35	593,409	42,256,291	71.21

Export of Cattle from Venezuela.

Consul Jerome B. Peterson reported from Puerto Cabello, Venezuela, under date of January 11, 1905, that figures recently published in the Boletín de Noticias show the exports of cattle from the port of Puerto Cabello from January 1, 1898, to December 31, 1904, to have been 299,437. These cattle weighed 214,227,906 pounds, and were valued at $5,105,750. There were included in this number 15,605 cows. The exports in the year 1904 alone amounted to 91,887 cattle, weighing 61,418,899 pounds and valued at $1,112,165.97. This number included 8,091 cows.

Number, average price, and farm value of cattle in the United States on January 1, 1905.

States and Territories.	Milch cows.			Other cattle.		
	Number.	Average farm price, Jan. 1.	Farm value.	Number.	Average farm price, Jan. 1.	Farm value.
Maine	189,125	$29.16	$5,514,885	121,216	$16.16	$1,959,191
New Hampshire	129,900	32.34	4,200,966	104,254	16.31	1,700,182
Vermont	285,315	24.06	6,864,679	225,870	14.37	3,246,605
Massachusetts	190,627	36.34	6,927,385	92,447	16.72	1,546,073
Rhode Island	25,466	41.70	1,061,932	10,444	17.71	184,939
Connecticut	130,863	34.94	4,572,353	85,743	17.33	1,485,702
New York	1,721,541	31.72	54,607,281	917,574	16.19	14,855,158
New Jersey	184,618	39.33	7,261,026	79,599	20.00	1,591,732
Pennsylvania	1,086,723	29.91	32,503,885	774,496	15.95	12,350,887
Delaware	35,127	29.25	1,027,465	20,962	17.44	365,614
Maryland	147,423	29.54	4,354,875	133,979	17.69	2,369,928
Virginia	252,727	24.92	6,297,957	431,827	16.60	7,166,172
North Carolina	193,482	20.90	4,043,774	301,524	10.37	3,126,860
South Carolina	109,704	24.64	2,703,107	173,071	10.92	1,890,053
Georgia	277,295	24.73	6,857,505	629,139	10.28	6,467,927
Florida	87,010	23.48	2,042,995	512,075	9.12	4,671,966
Alabama	230,120	19.63	4,517,256	367,972	7.82	2,876,660
Mississippi	272,004	22.50	6,120,090	389,281	8.20	3,191,832
Louisiana	166,320	22.84	3,798,749	400,896	9.78	3,922,363
Texas	838,431	19.82	16,617,702	8,249,749	10.09	83,260,593
Arkansas	280,863	17.27	4,850,504	473,654	7.54	3,570,070
Tennessee	282,529	21.88	6,181,735	424,886	10.94	4,650,169
West Virginia	180,379	28.05	5,059,631	338,305	19.73	6,674,865
Kentucky	286,716	24.00	6,881,184	512,989	15.54	7,972,828
Ohio	790,695	31.81	25,152,008	1,096,607	19.56	21,451,600
Michigan	556,149	28.77	16,000,407	699,914	14.32	10,019,412
Indiana	547,584	29.63	16,224,914	985,141	19.56	19,266,209
Illinois	995,429	29.53	29,395,018	1,666,872	20.74	34,573,093
Wisconsin	1,095,862	27.85	30,519,757	1,148,583	13.68	15,714,448
Minnesota	836,848	24.65	20,628,303	941,806	11.18	10,529,203
Iowa	1,335,832	27.90	37,269,713	3,467,507	19.42	67,348,010
Missouri	569,787	24.53	13,976,875	1,490,089	17.21	25,642,496
Kansas	671,276	23.69	15,902,528	2,682,299	17.21	46,159,947
Nebraska	669,334	25.83	17,288,897	2,379,478	17.34	41,249,675
South Dakota	401,703	24.65	9,901,979	1,470,563	16.59	24,389,434
North Dakota	194,332	26.18	5,087,612	598,705	16.47	9,858,878
Montana	55,030	32.88	1,809,386	1,048,455	18.42	19,314,006
Wyoming	20,167	34.58	697,375	812,061	21.33	17,321,264
Colorado	120,557	30.53	3,680,605	1,273,180	17.53	22,322,790
New Mexico	20,374	31.08	633,224	851,968	13.84	11,788,682
Arizona	19,233	35.50	682,772	512,294	16.11	8,252,594
Utah	72,971	31 12	2,270,858	254,301	16.69	4,243,297
Nevada	16,655	37.56	625,562	390,020	16.49	6,429,481
Idaho	59,620	30.35	1,809,467	358,251	16.39	5,871,095
Washington	159,088	31.31	4,981,045	306,438	16.27	4,986,606
Oregon	138,923	27.59	3,832,886	581,501	14.69	8,544,232
California	354,559	36.57	12,966,223	1,122,218	19.29	21,648,258
Oklahoma	186,730	19.35	3,613,226	1,284,399	13.32	17,102,925
Indian Territory	99,418	24.67	2,452,642	474,841	13.57	6,445,304
United States	17,572,464	27.44	482,272,203	43,669,443	15.15	661,571,308

Sale of blooded American heifers at Buenos Aires, Argentina, September 6, 1904.

Heifer.	Buyer.	Argentine paper.	American gold.
Lavender Daisy and calf	B. Gimenez Paz	$4,200.00	$1,785.00
Viscountess of Ravenswood 3d	....do	1,950.00	828.00
Second Elderlawn Victoria	Juan Chapar	1,800.00	765.00
Merry Ravenswood 3d	Leonardo Pereyra	1,500.00	637.00
Viscountess of Ravenswood 6th	Juan Chapar	1,500.00	637.00
Aconite Viscountess	Juan Stent	1,400.00	595.00
Merry Ravenswood	Ramon J. Carcano	1,350.00	573.00
Village Countess	B. Gimenez Paz	1,200.00	510.00
Pansy Blossom	Juan Chapar	1,200.00	510.00
Merry Ravenswood 2d	Ramon J. Carcano	1,100.00	467.00
Viscountess of Ravenswood 5th	Juan Stent	1,100.00	467.00
Viscountess of Ravenswood 7th	Ramon J. Carcano	1,100.00	467.00
Total		19,400.00	8,241.00
Average		1,616.66	686.75

Wholesale prices of cattle per 100 pounds, 1900 to 1904.

Date.	Chicago. Inferior to prime.		Cincinnati. Fair to medium.		St. Louis. Good to choice native steers.		Omaha. Native beeves.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1900.					1,000 to 1,400 lbs.			
January	$2.25	$6.60	$3.25	$4.25	$4.20	$6.00	$4.00	$6.25
February	2.25	6.10	3.35	4.35	4.20	5.75	3.75	5.55
March	2.25	6.05	3.40	4.50	4.55	5.50	3.75	5.20
April	2.25	6.00	3.75	4.65	4.50	5.75	3.75	5.25
May	2.50	5.80	4.10	4.70	4.50	5.50	4.00	5.30
June	2.25	5.90	4.00	4.60	4.40	5.60	4.00	5.40
July	2.25	5.75	3.75	4.50	4.25	5.70	4.00	5.50
August	2.25	6.10	3.65	4.60	4.25	6.00	4.00	5.80
September	2.25	6.00	3.75	4.60	4.20	5.85	3.75	5.70
October	1.75	6.00	3.10	4.40	4.10	5.85	3.75	5.50
November	1.75	6.00	3.00	4.15	4.00	5.85	3.75	5.50
December	1.75	....	3.00	4.35	4.10	6.50	3.50	7.50
1901.								
January	2.70	6.15	3.25	4.35	4.75	5.60	3.50	5.35
February	2.70	6.10	3.15	4.15	4.75	5.65	3.50	5.30
March	2.70	6.25	3.15	4.25	4.75	5.60	3.75	5.40
April	2.70	6.10	3.35	4.60	4.75	5.85	3.75	5.45
May	2.70	6.10	3.60	4.65	4.80	6.00	3.75	5.60
June	2.70	6.55	3.75	4.40	5.00	6.00	4.00	5.90
July	2.20	6.55	3.25	4.25	4.75	6.35	4.00	5.75
August	2.20	6.35	3.00	4.50	5.00	6.35	4.00	5.90
September	2.20	6.60	3.15	4.25	5.00	6.40	4.00	6.25
October	2.20	6.85	3.00	4.25	5.50	6.75	4.00	6.40
November	2.10	6.90	3.00	4.15	5.50	7.00	4.00	7.25
December	2.10	7.00	3.25	4.60	5.50	8.25	3.50	6.85
1902.								
January	2.20	7.75	3.75	4.65	6.10	7.00	3.40	6.55
February	2.25	7.35	3.65	4.75	6.35	6.50	3.50	6.25
March	2.35	7.35	3.75	5.25	6.40	6.75	4.00	6.70
April	2.35	7.50	4.25	5.40	6.95	7.10	4.50	7.00
May	2.50	7.70	4.10	5.35	6.90	7.50	4.35	7.40
June	2.35	8.50	3.25	5.25	7.50	8.00	4.25	7.85
July	2.25	8.85	3.15	5.25	7.50	8.35	5.00	8.15
August	2.40	9.00	3.25	5.25	7.40	8.75	5.00	8.15
September	2.25	8.85	3.00	4.40	6.60	8.00	4.15	7.85
October	1.90	8.75	2.90	4.25	6.35	7.10	4.50	7.25
November	2.00	7.40	3.00	4.15	5.15	7.25	3.20	6.00
December	2.00	14.50	3.00	4.25	5.25	6.00	3.00	6.25
1903.								
January	2.00	6.85	3.15	4.35	5.10	5.75	3.35	5.10
February	2.35	6.15	3.10	4.25	5.10	5.25	3.15	5.15
March	2.50	5.75	3.35	4.40	5.10	5.40	3.45	5.35
April	2.50	5.80	3.75	4.40	5.10	5.60	3.20	5.25
May	2.50	5.65	3.25	4.40	5.00	5.50	3.85	5.10
June	2.25	5.65	3.00	4.40	5.10	5.25	3.75	5.30
July	2.25	5.65	2.85	4.10	5.15	5.35	3.65	5.35
August	2.15	6.10	2.50	4.00	5.25	5.55	3.85	5.75
September	2.00	6.15	2.25	3.75	5.60	5.70	3.60	5.75
October	1.65	6.00	2.50	3.65	5.40	5.55	3.90	5.50
November	1.50	5.85	2.35	3.40	5.15	5.40	3.00	5.30
December	1.50	8.35	2.35	3.75	5.10	6.00	2.65	5.30
1904.								
January	2.10	5.90	3.00	4.00	5.15	5.35	3.20	5.10
February	2.25	6.00	3.00	3.75	4.90	5.35	3.00	5.50
March	2.15	6.00	3.00	4.00	5.00	5.35	2.75	5.20
April	2.25	5.80	3.15	4.00	5.25	5.40	3.00	5.10
May	2.35	5.85	3.10	4.25	5.05	5.35	3.00	5.55
June	2.35	6.70	3.00	4.25	5.75	6.40	3.50	6.25
July	2.20	6.65	3.00	4.25	5.90	6.25	3.40	6.00
August	2.20	6.40	2.65	4.00	5.60	6.00	3.25	5.85
September	2.15	6.40	2.50	3.75	5.75	6.00	4.00	6.00
October	1.70	7.00	2.50	3.75	6.05	6.60	4.25	6.35
November	1.70	7.15	2.50	3.50	5.15	6.60	3.10	6.15
December	1.80	7.65	2.25	3.60	5.75	6.00	3.10	6.15

Wholesale prices of butter per pound in leading cities of the United States, 1900–1904.

Date.	New York.		Cincinnati.		Chicago.		Elgin.	
	Creamery extra.		Creamery.		Creamery firsts.		Creamery extra.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1900.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	24	30	21	27	22	29	24	29
February	24	26	21	22	21	24½	24	24
March	23½	26	21	22	21	24½	24	24½
April	17½	23	16	20	15½	23½	18	22½
May	18½	19½	16	18	15½	19½	19½	19½
June	....	....	16	18	16½	19½	18	19½
July	19	20	17	18	17	19¼	19	19
August	18½	21	17	20	17	21	19½	21½
September	21	22	18	21	17½	21½	20½	21½
October	20½	22½	18	21	17	22	20½	22
November	22½	27	20	25	18	25½	22	26
December	25	26	23	24	20	24	24½	25
1901.								
January	21	25	18	24	15	23	21	24½
February	22	24	18	22	16	23	21	23½
March	22	23½	19	21	18	23	21½	23½
April	18	21	17	20	16	20½	20	21½
May	18	18	17	18	15½	18½	18½	18½
June	19	19½	17	19	16	19	18½	19
July	18	19	17	19	16	20	19	20
August	20	21	17	19	17	20½	20	21
September	20	22½	18	20	16	21	20	21
October	21	22½	20	21	17	22	21½	22
November	22½	25½	22	23	18	24½	22	24½
December	24	25½	22	23	20	24½	24½	24½
1902.								
January	23	26	22	23	20	24	24	24½
February	26	30	22	26	20	29	25½	29
March	27	30	23	24	22	28	26	28
April	22	33	23	27	18	31	22	30
May	22¼	25	19	20	19	23	22	22
June	21½	22½	19	20	18½	22	21	22
July	20½	21¾	18	21	18½	21½	20	21
August	19	20½	17	19	16	20	19	20
September	19½	23	17	21½	17	22½	19	22½
October	22½	25	20½	22½	19	24½	22½	24½
November	25	28½	21½	25	21½	27	24½	27
December	28	30	25	27	23	28½	28	29
1903.								
January	28½	28½	22	27	20	28	25	29
February	26	28	22	25	20	27½	25	27
March	27	29½	24½	26	24	28½	27½	28½
April	22½	29½	19½	26	21	28½	22½	28½
May	22	23	17½	20½	17	22	20	22½
June	20½	22½	18	21	18	22	20	22
July	19	20½	15½	20	17	20	18½	20
August	19	19¾	15½	18½	16	19	18½	19½
September	19¾	21¾	16½	20	17	21½	19½	21½
October	20	22¾	18	20	17	21½	20½	21½
November	22½	25½	19½	22½	18	24½	22	24
December	23	25½	21½	23½	19	25	24	25
1904.								
January	22	24½	19½	22½	17	23½	22	24
February	23	26½	21½	24	18	26	23	26
March	24	26½	22	24	19	26	24½	26
April	22	24½	20½	23	19	21½	23	24½
May	18	24½	17½	21½	15	23	17½	23
June	17¾	18¾	17½	19	15	18	17½	17½
July	17½	18	17	19	15	18	17	17½
August	17½	19½	17	19	15	18½	17	19
September	19	21	19	20½	16½	19½	19	20
October	20	23¼	20	22	17	22	20	23
November	23	26½	23	25½	19	24½	23	25
December	26	28	26½	28	20	28	25	28

Wholesale prices of cheese per pound in leading cities of the United States, 1900–1904.

Date.	New York.		Cincinnati.		Chicago.		St. Louis.	
	September, colored.		Factory.		Young Americas.		Full cream.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1900.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	12¾	13	12	12½	9	12½	12½	12½
February	12¾	13¼	12	12½	9	12½	12½	12½
March	13¼	13½	12	12½	9	12½	12½	12½
April	11	13½	12	12½	8½	12½	12	12½
May	9¼	11	9	11½	8½	10	10	11¾
June	9¼	10	8½	9	8¾	10¼	10	10½
July	9	9½	8½	9½	8	10¼	10½	10¾
August	9¼	10⅝	8½	10½	8	11½	10¾	12
September	12	12¼	10	10½	10	11½	10¼	11⅜
October	10⅝	11⅜	10½	11½	10	11½	11¾	12
November	10¾	11	10¾	11	10	11¼	11½	11¾
December	11	11½	10¾	11	10¼	10¾	11½	11½
1901.								
January	11¼	12	11	12	10½	11½	11½	11½
February	12	12½	11½	12	11½	11½	11	11½
March	12	12½	11½	12	11	11¾	12	12
April	11½	12½	11	12	11¼	11¾	11	12
May	8½	9½	8½	12	10½	11¾	10	11
June	9	9¾	8½	9½	9	10½	10	10¾
July	9	9½	8½	9½	9½	10¼	10	11¼
August	9⅝	9⅞	9	10	10	10½	11	11½
September	9½	10¼	9½	10	10	10¾	10½	11½
October	10¼	10¾	9½	10½	10	10¾	10½	11½
November	10¼	10¾	10	10½	9¾	10¼	10¾	11¼
December	10	11¼	10	10½	10	10¾	10¾	11¼
1902.								
January	11¼	11¾	10	11	10½	11¼	10¾	11½
February	11½	12½	10½	11½	10½	12½	12½	13
March	12¼	13¼	11	11½	11¾	12¼	13	14
April	13	13¼	11	12½	13	13	13¾	14½
May	10½	13	11½	12½	12¾	13½	12¾	14
June	9½	9¾	10½	12½	10¼	12¾	11	11½
July	9¾	10¼	10½	10½	10½	10¾	11½	11½
August	9½	10½	10½	10½	10½	11	11½	11¾
September	10⅜	12	10½	10½	10½	11¼	11¼	12
October	12	12½	11	12½	11¼	11¾	11¾	12½
November	12½	13	12	12½	11½	12	12¾	13½
December	13	13½	12	13	11½	13¼	13¾	14
1903.								
January	14	14	12½	12¾	13	13½	14	14¼
February	14½	14½	12½	12½	12½	13	14¼	14¼
March	14½	15	12½	12½	12½	13¼	14¼	14¼
April	15	15	12½	12½	12½	13¼	13½	14¼
May	11½	12¼	12½	12½	10½	13¾	12¾	14¾
June	10½	10¾	11	11¼	10½	10½	11½	11¾
July	10	10½	10½	10¾	10	10¾	11¾	12
August	10¼	10½	10½	10½	9	11	11¾	12
September	10⅞	12¼	10½	10½	9½	11	11¾	12¼
October	11½	12¼	10½	10½	10	11	11¾	12¼
November	11½	12	10½	10½	10	10½	11½	11½
December	12	12	10½	10½	10	10	11½	11½
1904.								
January	12	12	10½	10½	10	10	11½	11½
February	12	12	10½	10½	9½	10½	11½	11¾
March	12	12	10½	10½	10	10¾	12	12
April	10¾	12	10½	10½	9	10	9	11½
May	7	8	9½	10	8	9	10¼	10¼
June	7¾	9	8	9½	7¼	8½	9¼	10¼
July	8	9	8	8½	7½	8¾	9¼	9¾
August	8	9	8	9	7¾	8¾	9½	10
September	8¾	10	8½	9	8	8½	10	10¾
October	10	10½	8½	9	8¼	10½	11	11½
November	10¼	11¾	8½	10½	10	11½	11¾	13¼
December	11¾	12	10	10½	11	11½	13½	13½

SHEEP AND WOOL.

Number and farm value of sheep, 1880–1905.

January 1—	Sheep.		January 1—	Sheep.	
	Number.	Value.		Number.	Value.
1880	40, 765, 900	$90, 230, 537	1893	47, 273, 553	$125, 909, 264
1881	43, 569, 899	104, 070, 759	1894	45, 048, 017	89, 186, 110
1882	45, 016, 224	106, 595, 954	1895	42, 294, 064	66, 685, 767
1883	49, 237, 291	124, 365, 835	1896	38, 298, 783	65, 167, 735
1884	50, 626, 626	119, 902, 706	1897	36, 818, 643	67, 020, 942
1885	50, 360, 243	107, 960, 650	1898	37, 656, 960	92, 721, 133
1886	48, 322, 331	92, 443, 867	1899	39, 114, 453	107, 697, 530
1887	44, 759, 314	89, 872, 839	1900	41, 883, 065	122, 665, 913
1888	43, 544, 755	89, 279, 926	1901	59, 756, 718	178, 072, 476
1889	42, 599, 079	90, 640, 369	1902	62, 039, 091	164, 446, 091
1890	44, 336, 072	100, 659, 761	1903	63, 964, 876	168, 315, 750
1891	43, 431, 136	108, 397, 447	1904	51, 630, 144	133, 530, 099
1892	44, 938, 365	116, 121, 290	1905	45, 170, 423	127, 331, 850

Number, average price, and farm value of sheep in the United States on January 1, 1905.

States and Territories.	Number.	Average farm price Jan. 1.	Farm value.	States and Territories.	Number.	Average farm price Jan. 1.	Farm value.
Maine	270, 025	$3. 02	$815, 043	Indiana	1, 134, 771	$3. 81	$4, 320, 074
New Hampshire	75, 997	3. 22	245, 158	Illinois	705, 358	4. 27	3, 010, 821
Vermont	214, 445	3. 28	703, 680	Wisconsin	921, 632	3. 26	3, 007, 838
Massachusetts	40, 818	3. 86	157, 533	Minnesota	385, 003	3. 12	1, 202, 558
Rhode Island	8, 216	4. 11	33, 748	Iowa	698, 316	3. 80	2, 652, 483
Connecticut	33, 569	4. 19	140, 500	Missouri	770, 340	3. 13	2, 409, 624
New York	985, 480	4. 07	4, 009, 525	Kansas	229, 001	3. 10	709, 583
New Jersey	43, 344	4. 36	188, 841	Nebraska	419, 339	2. 98	1, 248, 666
Pennsylvania	895, 982	3. 81	3, 415, 394	South Dakota	806, 704	2. 99	2, 413, 095
Delaware	10, 512	3. 92	41, 237	North Dakota	702, 290	3. 08	2, 159, 823
Maryland	147, 208	3. 66	538, 267	Montana	5, 638, 967	2. 94	16, 551, 495
Virginia	452, 128	3. 10	1, 403, 813	Wyoming	3, 267, 887	2. 46	8, 034, 754
North Carolina	209, 118	1. 99	415, 727	Colorado	1, 458, 749	2. 68	3, 911, 344
South Carolina	58, 857	2. 05	120, 374	New Mexico	2, 856, 745	1. 98	5, 656, 356
Georgia	273, 893	1. 81	496, 102	Arizona	816, 141	2. 55	2, 083, 771
Florida	108, 736	1. 95	212, 177	Utah	2, 344, 108	2. 52	5, 908, 558
Alabama	189, 900	1. 65	312, 424	Nevada	1, 345, 791	2. 51	3, 378, 608
Mississippi	183, 739	1. 57	287, 736	Idaho	2, 978, 068	2. 62	7, 796, 285
Louisiana	174, 888	1. 79	313, 907	Washington	849, 618	2. 65	2, 253, 017
Texas	1, 617, 125	2. 08	3, 356, 344	Oregon	2, 546, 662	2. 30	5, 868, 274
Arkansas	204, 665	1. 60	327, 075	California	2, 180, 399	2. 67	5, 824, 718
Tennessee	297, 374	2. 27	676, 288	Oklahoma	63, 600	2. 79	177, 508
West Virginia	512, 671	3. 19	1, 635, 061	Indian Territory	26, 560	2. 90	76, 978
Kentucky	654, 999	2. 75	1, 800, 592				
Ohio	2, 601, 010	3. 41	8, 865, 284	United States	45, 170, 423	2. 82	127, 331, 850
Michigan	1, 759, 675	3. 50	6, 163, 789				

Imports and exports of sheep, with average prices, 1892–1904.

Year ended June 30—	Imports.			Exports.		
	Number.	Value.	Average price.	Number.	Value.	Average price.
1892	380, 814	$1, 440, 530	$3. 78	46, 960	$161, 105	$3. 43
1893	459, 484	1, 682, 977	3. 66	37, 260	126, 394	3. 39
1894	242, 568	788, 181	3. 25	132, 370	832, 763	6. 29
1895	291, 461	682, 618	2. 34	405, 748	2, 630, 686	6. 48
1896	322, 692	853, 530	2. 65	491, 565	3, 076, 384	6. 26
1897	405, 633	1, 019, 668	2. 51	244, 120	1, 531, 645	6. 27
1898	392, 314	1, 106, 322	2. 82	199, 690	1, 213, 886	6. 08
1899	345, 911	1, 200, 081	3. 47	143, 286	853, 555	5. 96
1900	381, 792	1, 365, 026	3. 58	125, 772	733, 477	5. 83
1901	331, 488	1, 236, 277	3. 73	297, 925	1, 933, 000	6. 49
1902	266, 953	956, 711	3. 58	358, 720	1, 940, 060	5. 41
1903	301, 623	1, 036, 934	3. 44	176, 961	1, 067, 860	6. 03
1904	238, 094	815, 289	3. 42	301, 313	1, 954, 604	6. 49

Prices of sheep per 100 pounds in leading cities of the United States, 1900–1904.

Date.	Chicago. Inferior to choice.		Cincinnati. Good to extra.		St. Louis. Good to choice natives.		Omaha. Native.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1900.								
January	$2.75	$5.25	$3.35	$4.75	$4.00	$5.25	$3.25	$5.25
February	3.25	5.85	4.00	5.75	4.75	5.50	3.50	5.75
March	4.00	6.00	5.00	6.00	5.25	5.75	3.50	6.10
April	4.25	6.50	5.00	6.00	5.25	6.25	3.50	6.10
May	3.75	6.50	3.00	4.75	4.50	5.50	3.50	6.00
June	3.25	5.70	2.75	4.50	4.25	4.75	3.25	5.25
July	2.75	5.15	2.25	4.25	3.90	4.30	3.00	4.60
August	2.60	4.70	2.00	4.25	3.50	4.25	3.00	4.60
September	2.50	4.25	2.00	3.90	3.40	4.00	2.50	4.00
October	2.50	4.25	1.50	4.00	3.50	4.00	2.00	4.00
November	2.50	4.35	1.25	3.75	3.50	4.00	2.00	4.25
December	2.50	5.00	1.25	3.75	3.65	4.25	2.25	4.35
1901.								
January	2.75	4.75	2.75	4.25	3.75	4.50	3.00	4.90
February	2.75	4.75	3.25	4.25	4.00	4.50	3.00	4.75
March	2.75	5.00	3.25	4.50	4.00	5.10	3.00	4.85
April	3.00	5.15	3.75	4.50	4.25	5.10	3.00	5.00
May	2.75	5.00	3.65	4.25	4.00	4.75	2.50	4.40
June	2.75	4.70	3.00	4.00	3.25	4.60	2.25	4.25
July	2.65	4.40	3.00	3.65	3.00	3.75	2.25	4.65
August	2.65	4.05	2.40	3.65	3.00	3.75	2.00	3.60
September	2.75	4.00	2.25	3.40	3.00	3.65	2.00	3.60
October	2.75	4.40	2.15	3.15	3.10	3.50	2.25	4.25
November	2.50	4.30	2.15	3.00	3.15	3.75	2.25	3.75
December	2.50	4.50	2.40	3.60	3.25	4.00	2.50	4.50
1902.								
January	2.00	4.75	3.00	4.25	4.25	5.00	4.00	5.15
February	2.00	5.50	3.50	5.50	4.75	5.60	4.20	5.85
March	3.00	5.75	4.25	5.50	5.50	5.75	4.40	5.90
April	2.50	6.50	3.75	5.50	5.50	6.25	4.75	6.25
May	2.25	6.50	4.35	5.75	6.00	6.35	5.40	6.00
June	1.50	6.25	3.50	4.60	3.70	5.60	4.50	6.00
July	1.75	5.00	3.10	4.00	4.00	4.60	3.80	4.50
August	1.50	4.25	2.25	4.00	3.85	4.35	....	....
September	1.50	4.50	2.00	3.40	3.65	4.00	2.00	3.40
October	1.50	4.25	2.65	3.40	3.90	4.00	3.00	4.10
November	1.50	4.25	2.50	3.35	3.75	4.00	3.40	4.25
December	1.25	4.75	2.75	4.00	3.80	4.50	3.50	4.75
1903.								
January	1.50	5.25	3.25	4.50	4.50	5.00	3.60	5.40
February	2.00	5.75	3.75	5.00	5.25	5.25	4.50	5.80
March	2.00	7.00	4.25	6.00	5.50	6.15	4.60	6.75
April	2.25	7.00	4.10	6.25	6.00	6.25	4.50	6.75
May	1.60	6.25	3.60	4.75	4.50	5.25	4.00	5.50
June	2.00	6.00	3.00	4.50	4.50	4.75	3.80	5.50
July	1.50	5.25	2.90	4.00	3.75	4.75	3.00	4.50
August	1.50	4.25	2.75	3.35	3.50	3.85	3.00	4.00
September	1.50	4.25	2.60	3.40	3.65	4.00	3.50	3.50
October	1.50	4.25	2.75	3.50	3.65	4.00	3.55	3.55
November	1.25	4.35	2.60	3.35	3.60	3.65	3.25	4.00
December	1.50	4.25	2.60	3.75	3.65	3.85	3.25	4.40
1904.								
January	2.00	4.75	3.25	4.00	3.75	4.75	2.25	5.10
February	2.00	4.75	3.40	4.60	4.75	4.75	2.60	5.25
March	2.00	5.50	3.65	4.50	4.75	4.90	2.50	5.25
April	2.50	6.00	4.00	4.50	5.40	5.60	3.25	5.65
May	2.00	6.00	3.75	4.55	5.50	5.65	4.00	5.90
June	1.75	5.50	3.00	4.40	4.60	5.50	4.00	5.25
July	1.50	5.50	2.75	4.00	4.00	4.25	3.75	5.00
August	2.00	4.25	2.75	4.00	3.75	4.00	3.40	4.35
September	1.75	4.50	2.75	3.50	3.75	4.00	....	....
October	1.50	4.75	2.75	3.50	4.10	4.50	....	....
November	1.75	5.00	2.75	4.00	4.25	4.75	3.75	4.50
December	2.50	5.65	3.50	4.50	4.75	4.90	4.00	5.50

Wool product of the United States for 1904, by States.

[Estimates of Mr. S. N. D. North.]

States and Territories.	Number of sheep Apr. 1, 1904.	Average weight of fleece, 1904.	Per cent of shrinkage, 1904.	Wool, washed and unwashed.	Wool, scoured.
		Pounds.		*Pounds.*	*Pounds.*
Maine	230,000	6	40	1,380,000	828,000
New Hampshire	63,000	6.2	50	390,600	195,300
Vermont	160,000	6	50	960,000	480,000
Massachusetts	30,000	5.8	45	174,000	95,700
Rhode Island	6,500	5.5	42	35,750	20,735
Connecticut	30,000	5	40	150,000	90,000
New York	675,000	6	50	4,050,000	2,025,000
New Jersey	32,000	5	47	160,000	84,800
Pennsylvania	850,000	6	52	5,100,000	2,448,000
Delaware	6,500	6	50	39,000	19,500
Maryland	100,000	5	47	500,000	265,000
Virginia	335,000	4.5	38	1,507,500	934,650
North Carolina	205,000	4	42	820,000	475,600
South Carolina	50,000	4	42	200,000	116,000
Georgia	250,000	3.8	40	950,000	570,000
Florida	100,000	3.5	40	350,000	210,000
Alabama	200,000	3.5	40	700,000	420,000
Mississippi	230,000	4	42	920,000	533,600
Louisiana	155,000	3.7	45	573,500	315,425
Texas	1,440,000	6.5	68	9,360,000	2,995,200
Arkansas	200,000	4	42	800,000	464,000
Tennessee	260,000	4.25	40	1,105,000	663,000
West Virginia	475,000	5.3	46	2,517,500	1,359,450
Kentucky	575,000	5	38	2,875,000	1,782,500
Ohio	2,033,072	6	52	12,198,432	5,855,247
Michigan	1,200,000	6.5	50	7,800,000	3,900,000
Indiana	700,000	6.5	50	4,550,000	2,275,000
Illinois	525,000	7.25	52	3,806,250	1,827,000
Wisconsin	700,000	6.75	48	4,525,000	2,353,000
Minnesota	350,000	7	52	2,450,000	1,176,000
Iowa	540,000	6.5	50	3,510,000	1,755,000
Missouri	575,000	6.5	49	3,737,500	1,906,125
Kansas	170,000	8	68	1,360,000	435,200
Nebraska	250,000	8	68	2,000,000	640,000
South Dakota	575,000	6.75	60	3,881,250	1,552,500
North Dakota	450,000	6.5	60	2,925,000	1,170,000
Montana	5,576,000	6.75	64	37,773,000	13,598,280
Wyoming	3,800,000	7.75	70	29,450,000	8,835,000
Colorado	1,300,000	7	68	9,100,000	2,912,000
New Mexico	3,150,000	5.5	64	17,325,000	6,237,000
Arizona	620,000	7	69	4,340,000	1,345,400
Utah	2,025,000	6.5	67	13,162,500	4,321,635
Nevada	600,000	7	70	4,200,000	1,260,000
Idaho	2,300,000	6.5	65	14,950,000	5,232,500
Washington	560,000	8	68	4,480,000	1,433,600
Oregon	2,000,000	7.25	69	14,500,000	4,495,000
California	1,625,000	7.25	68	11,781,250	3,770,000
Oklahoma and Indian Territory	60,000	6	68	360,000	115,200
United States	28,342,072	6.50	61.6	249,783,032	95,795,147
Pulled wool			33	42,000,000	28,140,000
Total product, 1904				291,783,032	123,935,147

Production of home-grown wool and imports of wool and sheepskins in the United Kingdom, 1900 to 1904.

[London Times.]

Year.	Home-grown wool production.	Foreign and colonial wool imported.	Sheepskins imported.	Total.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
1900	141,146,000	553,154,732	85,197,124	779,407,856
1901	138,483,000	686,956,308	84,159,984	909,599,292
1902	135,684,000	637,521,986	91,505,165	864,721,151
1903	133,124,000	599,500,932	100,963,976	833,588,908
1904	131,963,000	561,706,689	85,595,648	779,265,337

Wholesale prices of wool per pound in leading cities of the United States, 1900–1904.

Date.	Boston. XX Ohio, washed.		New York. XX Ohio.		Philadelphia. XX Ohio, washed.		St. Louis. Best tub-washed.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1900.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	37	38	36	39	36	37	29	35
February	37	37	36	39	36	37	35	36
March	34	36	36	39	36	37	33	35
April	32	34	36	37	34	35	33	34
May	31	32	34	37	33	34	33	34
June	29	31	34	36	30	32	28	32½
July	29	29	28	36	29	32	28	29
August	28	29	28	30	29	30	29	29
September	27½	28	28	30	28	30	29	29
October	27	27½	28	30	28	29	29	29
November	27	28	28	30	27	28	29	29½
December	28	28	28	30	27	28	29	29½
1901.								
January	27	28	26½	27	27	28	28	29½
February	27	27	26	26½	27	28	27	28
March	26	27	25½	26	26	27	27	27½
April	26½	26½	25½	26	25	27	27	27
May	26	26	25½	25½	25	27	25	27
June	26	26½	25½	25½	25	27	24	25
July	26½	27	25½	25½	25	26	....	....
August	27	27	25½	25½	26	27	24	24
September	26	27	25½	25½	26	27	24	25
October	26	26	25½	25½	26	27	24	24
November	26	27	25½	25½	26	27	24	25
December	26½	27	25½	25½	26	27	24	24½
1902.								
January	27	27	26	27	26	27	24	24½
February	27	27	26	27	26	27	24½	24½
March	27	27	26	27½	26	27	24	24
April	27	27	26½	27½	26	27	24	24
May	27	27	26½	27½	26	27	24	25
June	27	27½	26½	27½	26	27	24	25
July	27	28	26½	27½	26½	27½	24	25½
August	28	28	26½	27½	27½	28	25½	26½
September	29	29	26½	27½	27	29	26	26½
October	30	30	....	....	27	29	26	27
November	29	31	28	29	29	30	27½	28½
December	32	32	30	32	31	32	28	29
1903.								
January	32	32½	31	32	31	32	29	29
February	31	33	31	32	31	32	29	29
March	31	32	31	32	31	32	28	29
April	31	32	31	32	31	32	27	28½
May	30	32	30	33	31	32	27	28½
June	31	34	30	31	30	31	28	29
July	33	34	30	31	32	33	29	29½
August	33	35	31	33	32	33	29	29½
September	34	35	28	32	32	33	30	30
October	34	35	28	32	33	34	30	30½
November	34	35	28	32	33	34	30½	31
December	34	35	28	32	33	34	30½	30½
1904.								
January	33½	34	28	32	33	33	30½	30½
February	33	34	28	32	33	33	30½	31
March	33	34	28	32	33	33	30½	31
April	32	34	28	32	33	33	30½	31
May	32	33	28	32	32½	32½	30½	32
June	32	34	28	32	31½	31½	32	33
July	34	35	28	35	31½	33	33	34½
August	34	35	32	35	33	33	35	35
September	34	35	34	35	33	33	35	36
October	34	35	32	35	33	33	34½	36½
November	35	36	32	35	33	33½	37	40
December	34	36	32	35	33½	33½	40	41

Range of prices of wool in Boston, monthly, 1900–1904.[a]

[Cents per pound.]

Date.	Ohio fine, unwashed.		Indiana quarter-blood, unwashed.		Ohio XX, washed.		Ohio, No. 1, washed.		Ohio Delaine, washed.		Michigan X, washed.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1900.												
January	25	26	28	29	37	38	38	39	38	40	29	29
February	25	25	28	29	37	37	38	38	38	38	28	29
March	22	23	27	28	34	36	35	37	35	37½	24	27
April	21	22	25	27	32	34	35	35	35	35	24	24
May	20	21	25	26	31	32	34	35	33	35	24	24
June	19	20	25	25	29	31	32	33	32	33	23	24
July	19	19	24	25	29	29	31	32	31	32	23	23
August	19	19	23	24	28	29	30	31	29	31	22	23
September	18	19	23	24	27½	28	30	30	29	29	22	22
October	18	19	23	24	27	27½	28	29	27½	28	21½	22
November	18	19	23	24	27	28	28	29	28	30	22	23
December	18	18	23	24	28	28	28	28	29	29	22	22½
1901.												
January	17	18	23	23½	27	28	28	29	29	30	22	22
February	16½	17	23	24	27	27	27½	28	28	30	21	22
March	16½	18	22½	23	26	27	26	27	29	30	21	21
April	17	18	22	22½	26½	26½	26	27	28	30	21	21
May	17	17	20	21	26	26	25	26	28	30	20	20
June	17½	18	19½	20	26	26½	25	26	28	29	20	20½
July	18	18	20	20	26½	27	26	26	28	30	21	21½
August	18	18½	20	20	27	27	26½	26½	28	30	20½	21
September	18½	18½	20½	20½	26	27	26	26½	28	28½	21	21
October	18½	18½	20	20	26	26	25	26	28	28	20	21
November	19	19	20	21½	26	27	26	26½	27½	29	21	21
December	19	19½	21½	22	26½	27	26	27	28	29	21	21
1902.												
January	19½	20	22	22	27	27	27	27	28	29	21	21
February	20	20	22	22	27	27	27	27	28	29	21	21
March	19½	19½	21½	22	27	27	26½	27	28	29	21	21
April	19½	19½	21½	21½	27	27	26½	26½	28	28½	20½	21½
May	19	19½	20½	20½	27	27	26	26	28	28½	21	22
June	19	20	20½	21	27	27½	26	26	28	29	22	22
July	20	20	21	22	27	28	26	27	28	31	22	22
August	20	21	22	23	28	28	28	29	30	33	22	23
September	21½	21½	22	23	29	29	29	30	31½	32	23	23
October	21½	21½	23	23	30	30	30	30	31½	32	23	24
November	21½	22	23	23	29	31	30	31	31½	33	24	25
December	23	23	24	24	32	32	31	31	33	35	26	27
1903.												
January	22	23	23½	24	32	32½	31	32	34	35	27	27½
February	22	23	24	25	31	33	31	33	34	35	27	27½
March	22	23	22	24	31	32	31	32	33½	34	26	27
April	20	22	22	23½	31	32	30	31	33½	34	26	26½
May	20	22	22	23½	30	32	29	31	33½	35	25	26
June	21	24	22	25	31	34	30	33	34	37	25	26
July	23	24	23	25	33	34	32	33	36	37	[b]21	22
August	23	25	24	25	33	35	32	33	36	37	21½	22
September	24	25	24	25	34	35	32	33	36	37	21	22
October	24	25	24	25	34	35	32	34	36	37	21	22
November	24	25	24	25	34	35	33	34	35	37	21	22
December	24	25	24	25	34	35	33	34	35	36	21	22
1904.												
January	23	24	24	25	33½	34	32	33	35	36	21	22
February	22	24	24½	25½	33	34	32	33	35	36	20	22
March	22	24	24½	25½	33	34	32	33	35	36	20	21
April	22	23	25	25½	32	34	30	32	34	35	19	21
May	22	23	24	25	32	33	30	32	34	35	19	20
June	22	23	24	27	32	34	30	33	34	36	19	22
July	21	24	27	30	34	35	33	34	35	36	21	22
August	24	25	28	30	34	35	33	34	35½	36	21	22
September	24	25	28	29	34	35	33	34	35½	36	21	22
October	23	25	28	30	34	35	33	35	35½	36	21	22
November	23	25	30	32	35	36	35	38	35½	38	21	22
December	24	25	31	33	34	36	37	40	37	38	21	22

[a] Furnished by Commercial Bulletin, Boston.
[b] Since June 12, 1903, the standard quotation has been Michigan fine unwashed.

Range of prices of wool in Boston, monthly, 1900-1904—Continued.

[Cents per pound.]

Date.	Fine selected Territory, staple scoured.		Fine medium Territory, clothing scoured.		Texas, 12 months, scoured.		Fine free fall, Texas or California scoured.		Pulled, A super, scoured.		Pulled, B super, scoured.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1900.												
January	73	74	60	62	63	65	52	55	55	57	48	50
February	68	70	58	60	60	62	50	52	55	56	48	49
March	65	67	55	57	58	60	47	50	50	54	46	48
April	63	65	53	55	57	58	47	48	50	52	40	45
May	60	62	51	53	56	57	46	48	47	50	40	42
June	55	60	50	51	53	55	42	46	47	50	40	42
July	53	55	46	50	52	53	41	42	46	47	39	40
August	52	53	46	48	52	52	40	42	45	46	37	40
September	50	52	45	47	50	52	38	40	45	45	36	38
October	50	50	45	45	50	50	38	40	42	45	36	38
November	50	52	45	47	50	50	38	40	43	46	37	40
December	49	50	45	46	48	50	40	40	45	46	37	39
1901.												
January	50	50	39	43	48	48	38	40	42	45	37	38
February	48	50	38	39	47	50	37	40	40	45	35	35
March	43	45	35	38	43	45	36	38	38	42	34	35
April	45	47	38	40	43	47	36	37	38	40	33	34
May	45	47	40	40	45	47	36	37	35	38	31	32
June	45	47	40	42	45	47	36	37	35	39	30	30
July	46	48	42	43	47	50	36	40	37	40	31	33
August	47	50	43	44	48	50	40	40	38	40	33	33
September	49	50	44	44	50	50	40	40	38	40	33	33
October	49	50	42	44	50	50	40	40	38	40	32	32
November	49	50	43	44	48	50	40	42	38	40	32	33
December	49	50	43	44	48	50	40	42	38	40	34	34
1902.												
January	49	55	44	47	48	50	40	42	38	42	34	36
February	54	55	46	47	48	55	40	45	38	42	36	36
March	50	55	45	46	52	55	40	45	38	42	35	36
April	50	52	44	44	52	53	40	42	38	42	33	33
May	50	52	42	45	48	52	38	40	38	41	33	34
June	48	52	42	44	50	55	38	40	38	42	34	35
July	50	55	45	47	52	57	38	40	38	45	36	38
August	55	57	47	49	55	57	40	40	42	45	39	39
September	55	57	49	49	55	57	40	40	40	45	37	38
October	55	57	49	49	55	57	40	45	40	45	37	37
November	55	58	49	50	55	60	44	48	40	44	37	39
December	58	59	50	50	57	60	46	48	44	46	40	40
1903.												
January	56	60	54	58	57	60	46	48	44	46	40	42
February	55	58	52	56	55	58	45	48	43	46	40	43
March	54	56	52	54	55	57	45	46	42	45	39	42
April	51	55	52	53	55	57	45	46	40	44	39	41
May	52	55	50	53	53	57	45	46	40	45	39	42
June	52	55	50	53	53	57	45	48	42	46	40	42
July	53	55	52	53	55	57	46	48	43	47	40	41
August	54	56	52	53	55	57	46	48	45	47	43	44
September	55	56	52	53	55	57	46	48	44	47	42	44
October	55	56	52	53	55	57	46	48	44	47	42	43
November	53	56	51	53	55	56	45	48	44	47	40	43
December	53	55	51	52	55	56	44	46	43	45	40	42
1904.												
January	50	52	50	52	55	56	45	46	43	47	40	43
February	53	55	50	52	55	56	45	46	44	47	41	43
March	53	55	50	52	54	56	45	46	44	47	41	43
April	53	55	50	52	53	55	44	46	44	47	42	43
May	52	53	50	51	52	53	44	45	45	47	42	44
June	52	58	50	52	52	60	44	45	45	48	43	45
July	58	62	53	60	58	60	44	45	46	49	43	46
August	60	63	58	60	58	60	44	45	48	50	45	48
September	62	65	58	62	58	63	44	47	48	52	47	50
October	63	65	60	62	62	63	45	50	50	54	48	50
November	64	70	60	65	62	63	48	53	54	57	50	53
December	68	70	65	68	62	68	52	56	58	60	52	55

HOGS.

Number and farm value of hogs, 1880 to 1905, with exports.

Year.	On farms, January 1.			Exports for year ended June 30.		
	Number.	Value.	Average farm value.	Number.	Value.	Average price.
1880	34,034,100	$145,781,515	$4.28	83,434	$421,089	$5.05
1881	36,247,683	170,535,435	4.70	77,456	572,138	7.39
1882	44,122,200	263,543,195	5.97	36,368	509,651	14.01
1883	43,270,086	291,951,221	6.75	16,129	272,516	16.90
1884	44,200,893	246,301,139	5.57	46,382	627,480	13.53
1885	45,142,657	226,401,683	5.02	55,025	579,183	10.53
1886	46,092,043	196,569,894	4.26	74,187	674,297	9.09
1887	44,612,836	200,043,291	4.48	75,383	564,753	7.49
1888	44,346,525	220,811,082	4.98	23,755	193,017	8.13
1889	50,301,592	291,307,193	5.79	45,128	356,764	7.91
1890	51,602,780	243,418,336	4.72	91,148	909,042	9.97
1891	50,625,106	210,193,923	4.15	95,654	1,146,630	11.99
1892	52,398,019	241,031,415	4.60	31,963	364,081	11.39
1893	46,094,807	295,426,492	6.41	27,375	397,162	14.51
1894	45,206,498	270,384,626	5.98	1,553	14,753	9.50
1895	44,165,716	219,501,267	4.97	7,130	72,424	10.16
1896	42,842,759	186,529,745	4.35	21,049	227,297	10.80
1897	40,600,276	166,272,770	4.10	28,751	295,998	10.30
1898	39,759,993	174,351,409	4.39	14,411	110,487	7.67
1899	38,651,631	170,109,743	4.40	33,031	227,241	6.88
1900	37,079,356	185,472,321	5.00	51,180	394,813	7.71
1901	56,982,142	353,012,143	6.20	22,318	238,465	10.68
1902	48,698,890	342,120,780	7.03	8,368	88,330	10.56
1903	46,922,624	364,973,688	7.78	4,031	40,923	10.15
1904	47,009,367	289,224,627	6.15	6,345	53,780	8.48
1905	47,320,511	283,254,978	5.99	....	....	....

Number, average price, and farm value of hogs in the United States on January 1, 1905.

States and Territories.	Number.	Average farm price, Jan. 1.	Farm value.	States and Territories.	Number.	Average farm price, Jan. 1.	Farm value.
Maine	64,701	$9.45	$611,424	Indiana	2,631,470	$5.77	$15,183,582
New Hampshire	50,220	9.44	474,077	Illinois	3,747,120	6.74	25,255,589
Vermont	90,405	7.85	709,679	Wisconsin	1,653,316	7.78	12,862,798
Massachusetts	71,920	11.28	811,258	Minnesota	1,268,561	7.05	8,943,355
Rhode Island	12,569	12.22	153,593	Iowa	7,290,625	6.71	48,920,094
Connecticut	46,036	12.00	552,432	Missouri	3,110,582	4.50	13,997,619
New York	675,613	8.36	5,648,125	Kansas	1,949,782	6.25	12,186,138
New Jersey	150,988	10.40	1,570,275	Nebraska	2,888,844	6.51	18,806,374
Pennsylvania	980,080	8.28	8,115,062	South Dakota	836,824	6.63	5,548,143
Delaware	45,128	7.89	356,060	North Dakota	191,540	7.37	1,411,650
Maryland	290,324	7.41	2,151,301	Montana	57,592	8.11	467,071
Virginia	767,163	4.97	3,812,809	Wyoming	15,665	8.05	126,103
North Carolina	1,058,146	4.85	5,132,008	Colorado	77,357	7.22	558,518
South Carolina	664,907	5.52	3,670,287	New Mexico	21,126	5.80	122,531
Georgia	1,396,922	5.14	7,180,179	Arizona	18,184	7.44	135,289
Florida	383,741	3.49	1,339,256	Utah	56,250	7.62	428,625
Alabama	1,034,092	4.53	4,684,437	Nevada	14,157	8.47	119,910
Mississippi	1,087,780	4.80	5,221,344	Idaho	113,703	7.05	801,606
Louisiana	655,866	4.78	3,135,039	Washington	174,128	7.68	1,337,303
Texas	2,525,048	4.68	11,817,225	Oregon	268,933	6.06	1,629,734
Arkansas	1,031,245	3.63	3,743,419	California	521,384	6.10	3,180,442
Tennessee	1,011,516	4.70	4,754,125	Oklahoma	496,343	5.47	2,714,996
West Virginia	306,459	5.33	1,633,426	Indian Territory	708,823	4.73	3,352,733
Kentucky	1,185,636	3.99	4,730,688				
Ohio	2,701,250	6.30	17,017,875	United States	47,320,511	5.99	283,254,978
Michigan	920,447	6.67	6,139,381				

Wholesale prices of live hogs per 100 pounds in leading cities of the United States, 1900–1904.

Date.	Cincinnati.		St. Louis.		Chicago.		Omaha.	
	Packing, fair to good.		Mixed packers.					
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1900.								
January	$4.45	$4.80	$4.40	$4.75	$3.70	$4.92½	$4.15	$4.72½
February	4.85	5.05	4.75	5.05	3.70	5.10	4.40	4.90
March	4.95	5.25	4.85	5.45	4.00	5.52½	4.50	5.17½
April	5.25	5.85	5.45	5.75	4.25	5.85	5.00	5.62½
May	5.15	5.45	5.20	5.50	4.00	5.57½	4.50	5.40
June	5.00	5.30	5.00	5.35	4.10	5.42½	4.57½	5.25
July	5.25	5.55	5.30	5.50	4.25	5.55	4.75	5.25
August	5.25	5.40	5.25	5.50	3.60	5.57½	4.75	5.25
September	5.40	5.60	5.35	5.60	3.50	5.70	4.90	5.35
October	4.45	5.30	4.75	5.40	3.35	5.55	4.25	5.25
November	4.45	5.00	4.70	5.00	3.40	5.10	4.30	4.97½
December	4.60	5.15	4.75	4.95	4.00	5.45	4.55	5.00
1901.								
January	4.95	5.40	4.90	5.30	4.25	5.47½	4.90	5.35
February	5.20	5.75	5.05	5.45	5.10	5.65	5.10	5.42½
March	5.60	6.05	5.25	6.10	4.90	6.20	5.17½	6.00
April	5.65	6.20	5.60	6.15	4.40	6.25	5.50	6.10
May	5.60	5.95	5.50	5.90	4.15	5.97½	5.00	5.82½
June	5.75	6.20	5.70	6.25	4.25	6.30	5.50	6.07½
July	5.70	6.20	5.80	6.20	3.00	6.35	5.25	6.02½
August	5.85	6.80	5.75	6.60	3.00	6.60	5.05	6.45
September	6.75	7.20	6.60	7.10	3.00	7.40	5.85	6.90
October	5.70	6.95	5.90	7.00	4.25	7.10	5.60	6.85
November	5.35	5.70	5.45	6.10	3.75	6.30	4.45	6.15
December	5.80	6.40	6.00	6.50	4.00	6.70	5.40	6.80
1902.								
January	6.00	6.50	6.10	6.90	4.40	6.85	5.40	6.70
February	6.05	6.50	5.85	6.50	4.40	6.85	5.25	6.45
March	6.20	6.95	5.80	6.92½	4.75	7.00	5.50	6.75
April	6.75	7.30	6.80	7.50	5.40	7.50	6.20	7.30
May	6.65	7.25	6.70	7.50	5.40	7.50	6.50	7.35
June	6.70	7.70	6.95	7.95	5.65	7.95	6.70	7.75
July	7.25	8.00	7.50	8.15	5.70	8.75	6.85	8.05
August	6.40	7.70	6.70	8.12½	5.30	7.95	6.50	7.65
September	6.90	7.80	7.30	8.20	5.50	8.20	7.05	7.75
October	6.50	7.70	6.40	7.90	4.50	7.90	6.40	7.45
November	5.85	6.60	6.05	6.90	4.60	6.95	5.95	6.55
December	6.05	6.65	5.95	6.70	4.60	6.85	5.75	6.60
1903.								
January	6.25	6.95	6.15	6.95	5.00	7.00	6.00	6.85
February	6.70	7.30	6.60	7.30	5.30	7.55	6.35	7.20
March	7.05	7.75	6.95	7.60	6.00	7.85	6.75	7.55
April	6.70	7.45	6.50	7.40	6.30	7.65	6.60	7.40
May	5.75	6.85	5.80	7.05	5.10	7.15	5.50	6.90
June	5.70	6.25	5.50	6.20	5.25	6.35	5.50	6.20
July	5.15	5.90	5.30	5.95	4.60	6.20	4.90	5.65
August	5.40	6.05	5.20	5.90	4.50	6.15	4.92½	5.80
September	5.80	6.35	5.55	6.20	4.85	6.45	5.05	6.00
October	5.10	6.20	5.30	6.25	4.00	6.50	4.80	5.85
November	4.15	5.35	4.50	5.50	3.75	5.50	4.10	5.25
December	4.25	4.95	4.20	4.85	3.80	4.90	4.15	4.70
1904.								
January	4.75	5.25	4.65	5.25	3.85	5.20	4.20	5.00
February	4.85	5.85	4.70	5.80	3.90	5.80	4.50	5.60
March	5.35	6.00	5.20	5.75	4.00	5.82½	4.60	5.40
April	4.90	5.50	4.75	5.67½	3.75	5.30	4.50	5.17½
May	4.50	5.00	4.55	4.90	3.70	4.95	4.20	4.77½
June	4.55	5.55	4.57½	5.50	4.00	5.47½	4.27½	5.27½
July	5.25	5.95	5.10	5.75	4.70	5.90	4.50	5.37½
August	5.20	5.85	5.10	5.72½	4.60	5.80	4.65	5 40
September	5.55	6.25	5.30	6.25	4.70	6.37½	5.00	6.05
October	5.00	6.10	4.90	6.30	4.40	6.27½	4.92½	5.85
November	4.45	5.20	4.50	5.17½	3.65	5.25	4.45	5.00
December	4.35	4.90	4.25	4.85	3.60	4.87½	4.25	4.65

Monthly average prices of live hogs in Chicago.[a]

[In dollars per 100 pounds.]

Month.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
January	4.22½	7.45	5.27½	4.25	3.90	3.30	3.67½	3.67½	4.53¾	5.13¾	6.20	4.70
February	4.57½	7.97½	5.07½	4.12½	3.97½	3.42½	3.93¾	3.75	4.82½	5.37½	6.00	5.05
March	4.55	7.55	4.72½	4.57½	3.90	3.80	3.91¼	3.75	5.07½	5.70	6.32½	5.26¼
April	4.50	7.02½	4.97½	4.91¼	3.60	3.87½	3.87½	3.82½	5.47½	5.90	6.92½	4.95
May	4.55	7.40	4.87½	4.53¾	3.27½	3.65	4.25	3.75	5.23¾	5.75	6.95	4.57½
June	4.97½	6.62½	4.75	4.65	3.15	3.37½	4.02½	3.72½	5.13¾	5.92½	7.30	4.90
July	5.65	5.60	5.30	5.10	3.10	3.52½	3.88¾	4.12½	5.20	5.85	7.62½	5.32½
August	5.40	5.05	5.35	4.62½	3.10	4.00	3.82½	4.42½	5.16½	6.05	7.02½	5.17½
September	5.15	6.00	5.82½	4.10	2.97½	4.12½	3.77½	4.40	5.27½	6.60	7.50	5.53⅝
October	5.36¼	6.37½	5.12½	3.85	3.10	3.80	3.62½	4.35	4.92½	6.27½	6.96¼	5.41¼
November	5.48¾	5.70	4.32½	3.52½	3.30	3.47½	3.47½	3.95	4.73¾	5.65	6.35	4.70
December	6.12½	5.12½	4.32½	3.47½	3.25	3.35	3.42½	4.00	4.75	6.00	6.25	4.98¾
Yearly average	5.04⅝	6.49	4.99⅜	4.31	3.38½	3.64⅛	3.80¾	3.97¾	5.02¾	5.85⅛	$6.78\frac{7}{10}$	$5.04\frac{25}{32}$

[a] This table exhibits average cash prices of live hogs for the past twelve years. The monthly prices are the means between the lowest and highest prices for each month, and the yearly prices are averages of the monthly averages.

EGGS.

Wholesale prices of eggs per dozen in leading cities of the United States, 1900–1904.

Date.	New York. Average best fresh.		Cincinnati.		Chicago. Fresh.		St. Louis. Average best fresh.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1900.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	17	26	15	19	13¾	20	12½	17½
February	13½	19	12½	14	12	16	10½	14
March	12	17	9½	14	10	16	8¾	15½
April	12	13½	9½	11	10¼	11¼	8¾	11¼
May	12½	14½	10½	11	10¾	11½	9½	10
June	13	15	10½	11	10	11¼	8	10
July	13	17	9	10	10½	11½	7½	9½
August	14	18	9	12	11½	13½	9½	11½
September	12½	14	11½	15	13	16	16	19½
October	19	21	14	16	15½	17½	14	16½
November	20	27	16	20	18	23	16	18½
December	23	29	18	22	20	26	18	23
1901.								
January	19½	27	16	20	17	23	15½	18½
February	17	21½	15	17½	14	19½	14½	17½
March	13	17½	11	15	11½	17	10½	13
April	13½	14	11	12	12	12¾	10½	12
May	13½	14½	11	11	10½	12¼	10	10¾
June	13	14½	11	11	10	12	8½	10
July	14	18	9	10	10	13	6	9
August	16	20	9	13	12½	14½	9	11½
September	18	22	13½	17	13	17	12	16½
October	20	23	17	17	16½	19	16	18
November	22	29	17	23	19	23½	18	22
December	23	31	23	25	23	28	22	25
1902.								
January	26	34	22	30	18	28	22	26
February	27	37	21	32	23½	33½	21	32
March	15½	30	13½	23	13¾	26½	13½	26½
April	15½	18	14	15	14	16	13½	15½
May	16	17½	14	15	14½	15½	13½	15
June	17	20	14	14½	14¾	17	13	15½
July	18	20½	14	14½	17	18	11¼	14½
August	18	21	14	16	16	18	13	16
September	20	24	16½	18½	17	20½	15	20
October	21	25	18	21	20	22	17	18½
November	22	26	19	23	21½	24	19½	22½
December	24	29	21	23	20	25	20½	22½

Wholesale prices of eggs per dozen in leading cities of the United States, 1900–1904—Cont'd.

Date.	New York.		Cincinnati.		Chicago.		St. Louis.	
	Average best fresh.				Fresh.		Average best fresh.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1903.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	24	28	20	26	21	26½	17½	22½
February	16	25	12	20	14	20	12½	18
March	14½	21	12	16½	12½	20	11	16½
April	15	17½	12	14	12¼	15½	11	14¼
May	16	19	13½	14	13	15	12¼	14
June	17½	19½	13½	14	12½	15½	12½	15
July	18½	23	12	14	11	16	11	12½
August	15½	26	12½	18	10	19	14	19
September	19	28	18	19	16	20	18¼	19
October	21	33	19	22	17	23	19	21½
November	22	45	20	28	18	28	21½	26
December	28	45	20	26	22	30	24	28½
1904.								
January	27	47	23	32	22	34½	28	29
February	20	40	19	29	18	33½	17¾	29
March	16	25	14½	20	14¾	20	13¼	16
April	17	21	15½	17	15½	18½	14½	15½
May	17	21	15	17	14	18	13	15½
June	17½	21	15½	16	13	17½	14½	15½
July	17½	24	15½	16	11	20	13	17½
August	19	26	15	18	11	20½	16	19½
September	20	30	16	19	13	22	17½	20½
October	20	30	18	20	13	23½	19	20½
November	21	38	21	26	17	28	21½	27
December	20	40	22	27	16	30	24	27

TRANSPORTATION RATES.

Average freight rates on grain, in cents, from St. Louis to Liverpool, via river to New Orleans, and via rail to New York.

Year.	To New Orleans by river.		On wheat to New York by rail, per 100 pounds.	To Liverpool.	
	On grain in sacks, per 100 pounds.	On wheat in bulk per bushel.		Via New Orleans on wheat, per bushel.	Via New York on wheat, per bushel.
1881	20	6	32	....	....
1882	20	$6\frac{5}{12}$	29½	22⅔	23⅔
1883	17¾	5⅓	33	$19\frac{7}{12}$	27
1884	14	6⅛	26	$14\frac{7}{12}$	21¼
1885	15	6⅗	$22\frac{1}{7}$	15⅙	20½
1886	16	6½	29	16⅙	24
1887	18¼	6	$32\frac{2}{15}$	15	24⅓
1888	15	6½	29½	15⅙	22.95
1889	17.93	5.95	28½	17⅓	24.97
1890	15.66	6.58	27⅝	14⅓	21.48
1891	16.28	6.87½	29	15¾	23.55
1892	16.87	6.50	26.62	14	21
1893	17.54	6.55	28.50	14.71	21.72
1894	17.14	5.89	24.73	11.69	18.71
1895	13.00	5.95	23.57	12⅛	18.33
1896	14.54	5.00	23.00	13.50	19.67½
1897	10.83	4.88	23.64	12.89	20.33
1898	10.00	4.50	22.25	14.24	20.32
1899	10.00	4.50	21.95	12.83	17.88
1900	10.00	*a* 4.25	19.38	14.64	18.41
1901	10.00	*a* 4.25	19.33	9.48	14.03
1902	10.00	*a* 4.20	20.66	8.53	15.33
1903	10.00	*a* 5.00	22.25	10.00	16.02
1904	(*b*)	(*b*)	21.51	(*b*)	15.25

a F. o. b. New Orleans. *b* No shipment.

Live stock and dressed meats, Chicago to New York by rail, average rates, in cents, per 100 pounds.

Year.	Cattle.	Hogs.	Sheep.	Horses and mules.	Dressed beef.	Dressed hogs. Refrigerator cars.	Dressed hogs. Common cars.	Year.	Cattle.	Hogs.	Sheep.	Horses and mules.	Dressed beef.	Dressed hogs. Refrigerator cars.	Dressed hogs. Common cars.
1881	35	31	61	60	56	......	......	1893	28	20	30	60	45	45	45
1882	36	29	53	60	57	......	......	1894	28	30	30	60	45	45	45
1883	40	32	50	60	64	......	......	1895	28	30	30	60	45	45	45
1884	31	28	44	60	51	......	......	1896	28	30	30	60	45	45	45
1885	31	26	43	60	54	......	......	1897	28	30	30	60	45	45	45
1886	33	30	42	60	61	53	48	1898	28	30	30	60	45	45	45
1887	33	32	40	60	62	59	54	1899	a25	25	25	60	40	40	40
1888	22	26	31	60	46	46	44	1900	28	30	30	60	45	45	45
1889	25	30	30	60	47	47	45	1901	28	30	30	60	42.9	42.9	42.9
1890	23	28	30	60	39	39	39	1902	28	30	30	60	41.2	41.2	41.2
1891	27	30	30	60	45	45	45	1903	28	30	30	60	45	45	45
1892	28	28	30	60	45	45	45	1904	28	30	30	60	45	45	45

[a] Rates did not go into effect until February 1, 1899; until that time the 1898 rates governed.

Meats, packed, Cincinnati to New York by rail, average rates, in cents, per 100 pounds.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	The year.
1880	39	39	39	31.5	30.5	30.5	30.5	30.5	30.5	30.5	31.5	35	33.41
1881	35	35	35	30.5	30.5	25.7	21.5	21.5	21.5	21.5	21.5	21.5	26.73
1882	......	21.5	24.3	26	26	26	26	26	26	26	26	30.5	25.85
1883	30.5	30.5	30.5	29.2	26	26	26	26	26	26	26.7	30.5	27.83
1884	30.5	30.5	23.3	17.5	17.5	18.4	23	26	26	26	26	26	24.22
1885	24.4	21.5	20	20.6	18.5	17.5	17.5	21.5	21.5	21.5	22.8	26	21.10
1886	26	26	26	26	26	26	26	26	26	26	26	27.7	26.14
1887	30.5	30.5	30.5	26	26	26	26	26	26	26	26	26	27.12
1888	28	28.5	26.3	26	26	26	19.9	17.3	15.5	18.8	21.5	23.6	23.11
1889	26	26	26	26	26	26	26	26	26	26	26	26	26
1890	26	26	26	26	26	26	26	24.8	20	20	20	20	23.89
1891	20	21.3	26	26	26	26	26	26	26	26	26	26	25.36
1892	26	26	26	26	26	25.7	21.5	21.5	21.5	21.5	21.5	21.5	23.70
1893	21.5	23.7	26	26	26	26	26	26	26	26	26	26	25.43
1894	26	26	26	26	26	26	26	26	26	26	26	26	26
1895	26	26	26	26	26	26	26	26	26	26	26	26	26
1896	26	26	26	26	26	26	26	26	26	26	26	26	26
1897	26	26	26	26	26	26	26	26	26	26	26	26	26
1898	26	26	26	26	26	26	26	26	26	26	26	26	26
1899	26	26	26	26	26	26	26	26	26	21.5	21.5	21.5	24.83
1900	26	26	26	26	26	26	26	26	26	26	26	26	26
1901	26	26	26	26	26	26	26	26	26	26	26	26	26
1902	26	26	26	26	26	26	26	26	26	26	26	26	26
1903	26	26	26	26	26	26	26	26	26	26	26	26	26
1904	26	26	26	26	26	26	26	26	26	26	26	26	26

Compressed cotton by rail, average rates, in cents, per 100 pounds.

Year.	From New Orleans to[a]— Boston.	New York.	Philadelphia.	Baltimore.	From Memphis to— New York.	Boston.	Year.	From New Orleans to[a]— Boston.	New York.	Philadelphia.	Baltimore.	From Memphis to— New York.	Boston.
1881	58	53	54	54	66	71	1893	55	50	50	50	47	52
1882	53	48	51	51	61	66	1894	51	50	50	50	50.5	55.5
1883	60	55	53	52	72	77	1895	53	48	48	48	50.5	55.5
1884	60	55	53	52	54	59	1896	55	50	50	50	50.5	55.5
1885	60	55	53	52	56	58	1897	55	50	50	50	50	55
1886	52	47	45	44	53	58	1898	55	50	50	50	47	52
1887	50	45	43	42	53	58	1899	52	47	47	47	48	53
1888	50	45	43	42	47	52	1900	55	50	50	50	50.5	55.5
1889	52	47	45	44	50.5	55	1901	55	50	50	50	50.5	55.5
1890	55	50	50	50	50.5	55	1902	55	50	50	50	50.5	55.5
1891	55	50	50	50	50.5	55	1903	55	50	50	50	50.5	55.5
1892	55	50	50	50	50.5	55	1904	55	50	50	50	50.5	50.5

[a] These rates are mainly used for basing purposes.

Corn and wheat, average rates in cents per bushel, Chicago to New York.

Year.	Corn.			Wheat.		
	By lake and canal.[a]	By lake and rail.	By all rail.	By lake and canal.[a]	By lake and rail.	By all rail.
1875	....	11.34	19.5	....	12.09	20.89
1876	8.75	9.68	14.12	9.82	10.19	15.12
1877	9.59	13.42	18.03	11.09	14.75	19.56
1878	8.83	10.45	16.39	9.96	11.99	17.56
1879	10.49	12.2	14.56	11.87	13.13	17.74
1880	13.41	14.43	17.48	13.13	15.8	19.8
1881	7.77	9.42	13.4	8.67	10.49	14.4
1882	6.72	10.28	13.5	7.23	10.91	14.47
1883	8.03	11	15.12	9.01	11.63	16.2
1884	6.55	8.5	12.32	7	10	13.2
1885	6.3	8.01	12.32	6.54	9.02	13.2
1886	8.45	11.2	14	9.10	12	15
1887	8.5	11.2	14.7	9.5	12	15.75
1888	6.71	10.26	13.54	7.05	11.14	14.5
1889	6.32	8.19	12.6	6.92	8.97	15
1890	5.93	7.32	11.36	6.76	8.52	14.3
1891	6.32	7.53	14	6.95	8.57	15
1892	5.95	7.21	12.96	6.45	7.59	13.8
1893	7.18	7.97	13.65	7.66	8.48	14.63
1894	4.93	6.5	12.32	5.11	7	13.2
1895	4.50	6.4	10.29	4.86	6.96	11.89
1896	5.75	6.15	10.5	6.19	6.61	12
1897	4.53	6.92	11.43	5.22	7.42	12.5
1898	3.81	4.41	9.8	[b]4.45	4.91	12
1899	5.08	5.83	10.08	[b]5.81	6.63	11.6
1900	4.07	4.72	9.19	[b]4.49	5.1	9.96
1901	4.61	5.16	9.21	[b]5.11	5.54	9.88
1902	4.83	5.51	9.94	[b]5.26	5.89	10.62
1903	4.85	5.78	10.51	[b]5.4	6.37	11.29
1904	[b]3.63	4.82	10.38	[b]4.73	5.50	11.12

[a] Including Buffalo charges and tolls. [b] Exclusive of Buffalo charges.

Average freight rates, in cents per ton per mile.

Year.	Fitchburg R. R.	Boston and Albany R. R.	New York Central and Hudson River R. R.	Erie R. R.	Lake Shore and Michigan Southern Rwy.	Pennsylvania R. R.	Pittsburg, Fort Wayne and Chicago Rwy.	Chesapeake and Ohio Rwy.	Illinois Central R. R.	Chicago, Rock Island and Pacific Rwy.	Chicago, Milwaukee and St. Paul Rwy.	Chicago and Alton Rwy.	Union Pacific Rwy.	Louisville and Nashville R. R.	All railways in the United States.
1875	3.624	1.346	1.119	1.061	0.887	0.989	0.970	1.299	1.691	1.688	1.833	1.649	2.164	1.687	1.421
1876	2.218	1.139	.929	.972	.722	.841	.827	1.062	1.587	1.693	1.798	1.438	2.211	1.638	1.217
1877	1.955	1.136	.954	.898	.813	.954	1.024	1.035	1.719	1.563	1.949	1.361	2.135	1.382	1.286
1878	1.582	1.113	.919	.960	.724	.914	.867	.985	1.616	1.539	1.762	1.354	2.236	1.635	1.296
1879	1.299	1.100	.793	.779	.641	.823	.754	.860	1.523	1.429	1.704	1.054	1.991	1.528	1.153
1880	1.36	1.207	.879	.836	.750	.918	......	.866	1.543	1.209	1.749	1.296	......	1.504	1.232
1881	1.26	1.038	.783	.805	.617	.857	.745	.892	1.522	1.220	1.702	1.241	2.178	1.503	1.188
1882	1.17	1.064	.738	.749	.628	.874	.752	.753	1.417	1.281	1.481	1.253	2.102	1.349	1.102
1883	1.19	1.197	.915	.786	.728	.881	.787	.722	1.433	1.170	1.391	1.128	1.913	1.323	1.205
1884	1.09	1.093	.834	.719	.652	.804	.673	.672	1.368	1.097	1.293	1.008	1.557	1.344	1.136
1885	1.06	.944	.688	.656	.553	.695	.577	.550	1.307	1.043	1.278	1.009	1.420	1.159	1.011
1886	1.07	1.101	.765	.659	.639	.755	.692	.511	1.157	1.071	1.168	.961	1.266	1.079	.999
1887	1.13	1.107	.782	.687	.670	.730	.717	.537	1.087	1.012	1.089	.946	1.213	1.075	.984
1888	1.116	1.099	.753	.716	.861	.723	.660	.541	1.068	.964	1.020	.973	1.170	1.049	1.001
1889	1.015	1.030	.712	.644	.632	.685	.69	.538	.839	.971	1.067	.525	1.166	.998	.922
1890	.995	1.105	.730	.665	.644	.661	.69	.561	.942	.995	.995	.898	1.138	.972	.941
1891	.991	1.089	.740	.636	.630	.656	.70	.525	.934	1.039	1.003	.980	1.131	.968	.895
1892	.925	1.057	.699	.614	.602	.647	.67	.518	.908	1.055	1.026	.973	1.080	.948	.898
1893	.923	1.006	.701	.631	.599	.620	.68	.511	.845	1.039	1.026	.949	1.033	.917	.878
1894	.895	.944	.733	.621	.587	.606	.65	.478	.839	.989	1.037	.974	.970	.876	.860
1895	.878	.969	.726	.604	.567	.565	.64	.425	.808	1.084	1.075	.994	.971	.831	.839
1896	.864	.942	.668	.606	.551	.563	.66	.425	.745	1.017	1.003	.925	.957	.806	.806
1897	.870	.918	.679	.610	.538	.561	.60	.419	.671	.958	1.008	.891	.962	.791	.798
1898	.844	.839	.606	.575	.530	.521	.57	.369	.695	.966	.972	.866	.950	.743	.753
1899	.771	.778	.586	.539	.481	.469	.50	.362	.688	.996	.937	.800	1.016	.727	.724
1900	.798	.824	.558	.588	.490	.504	.58	.343	.650	.987	.930	.794	1.050	.752	.729
1901	(a)	.831	.575	.615	.489	.562	.56	.388	.619	1.000	.861	.723	1.042	.772	.750
1902	(a)	(b)	.632	.664	.503	.590	.61	.402	.622	1.034	.840	.678	.979	.744	.757
1903	(a)	(b)	.634	.637	.519	.598	.62	1.114	.591	1.013	.865	.599	.973	.781	.763

[a] Leased by the Boston and Maine Railroad.
[b] Leased by the New York Central and Hudson River Railroad.

Average rates, in cents per passenger per mile.

Year.	Fitchburg R. R.	Boston and Albany R. R.	New York Central and Hudson River R. R.	Erie R. R.	Lake Shore and Michigan Southern Rwy.	Pennsylvania R. R.	Pittsburg, Fort Wayne and Chicago Rwy.	Chesapeake and Ohio Rwy.	Illinois Central R. R.	Chicago, Rock Island and Pacific Rwy.	Chicago, Milwaukee and St. Paul Rwy.	Chicago and Alton Rwy.	Union Pacific Rwy.	Louisville and Nashville R. R.	All railways in the United States.
1875....	1.910	2.180	1.885	1.955	2.088	2.259	2.407	3.231	2.882	2.687	2.690	2.755	2.878	3.219	2.378
1876....	1.864	2.099	1.693	1.859	1.846	1.819	1.830	3.322	2.804	2.626	2.805	2.614	2.974	3.018	2.183
1877....	1.947	2.174	1.953	1.772	2.182	2.185	2.192	3.786	2.942	2.772	2.994	2.798	3.140	3.167	2.458
1878....	1.969	2.217	1.978	2.158	2.255	2.277	2.258	3.738	3.122	2.933	3.029	2.795	3.226	3.345	2.573
1879....	1.888	2.137	2.044	2.090	2.221	2.253	2.228	3.630	3.066	2.971	2.908	2.417	......	3.444	2.484
1880....	1.885	2.096	1.999	2.041	2.135	2.222	2.156	2.959	2.514	2.806	2.868	2.076	......	3.476	2.442
1881....	1.820	1.970	1.862	2.016	1.988	2.152	1.895	2.989	2.164	2.666	2.856	1.828	3.341	3.168	2.446
1882....	1.715	1.993	1.808	1.948	2.156	2.249	2.024	2.605	2.388	2.505	2.579	1.951	3.300	2.706	2.391
1883....	1.790	2.088	1.986	1.673	2.196	2.297	2.193	2.373	2.424	2.504	2.516	2.141	3.128	2.614	2.402
1884....	1.651	1.908	1.942	2.189	2.170	2.258	2.222	2.379	2.225	2.572	2.553	1.900	2.952	2.342	3.323
1885....	1.833	1.838	1.419	1.756	2.058	1.950	1.569	2.270	2.211	2.466	2.563	2.026	2.749	2.103	2.216
1886....	1.756	1.853	1.845	1.890	2.098	2.114	2.130	2.131	2.208	2.420	2.415	2.023	2.135	2.436	2.142
1887....	1.89	1.880	1.989	2.029	2.260	2.125	2.255	2.074	2.268	2.328	2.538	2.062	2.301	2.394	2.245
1888....	1.978	1.976	1.967	1.851	2.280	2.111	2.10	2.025	2.197	2.312	2.445	2.123	2.248	2.429	2.349
1889....	1.957	1.869	1.932	1.722	2.286	2.076	2.18	1.709	1.927	2.285	2.415	2.128	2.135	2.370	2.165
1890....	1.915	1.858	1.910	1.584	2.254	2.094	2.25	2.056	2.022	2.149	2.359	2.004	2.045	2.403	2.167
1891....	1.869	1.818	1.905	1.601	2.105	2.070	2.23	2.155	2.073	2.322	2.408	2.205	2.059	2.483	2.142
1892....	1.916	1.828	1.887	1.589	2.183	2.028	2.00	2.181	2.101	2.308	2.464	2.043	2.104	2.448	2.126
1893....	1.869	1.835	1.832	1.551	2.195	1.968	1.98	1.989	1.999	2.095	2.414	1.981	1.987	2.432	2.108
1894....	1.851	1.794	1.857	1.509	2.069	1.993	2.00	1.905	1.925	1.891	2.191	1.776	1.758	2.365	1.986
1895....	1.819	1.770	1.837	1.560	2.215	1.971	2.06	1.980	1.995	2.146	2.411	2.119	1.962	2.318	2.040
1896....	1.769	1.752	1.838	1.641	2.148	1.950	1.88	1.952	1.979	2.108	2.375	2.117	2.075	2.187	2.019
1897....	1.811	1.754	1.842	1.543	2.108	1.958	2.02	1.980	1.979	2.153	2.289	2.116	2.101	2.254	2.022
1898....	1.826	1.750	1.806	1.548	2.032	a1.953	2.02	1.943	1.938	2.092	2.362	2.058	1.945	2.152	1.973
1899....	1.800	1.744	1.766	1.536	2.074	a1.937	2.02	1.860	2.014	2.036	2.337	2.055	1.941	2.243	1.925
1900....	1.805	1.754	1.793	1.540	2.223	1.952	2.05	1.973	2.021	2.064	2.346	1.908	1.968	2.318	2.003
1901....	(b)	1.742	1.799	1.541	1.993	1.992	2.09	1.984	1.960	2.095	2.324	1.936	2.085	2.355	2.013
1902....	(b)	(c)	1.723	1.531	1.828	1.999	2.04	2.023	1.999	2.135	2.317	1.860	2.007	2.319	1.986
1903....	(b)	(c)	1.773	1.500	2.066	a2.015	2.05	2.044	1.971	2.157	2.309	1.981	1.941	2.369	2.006

a Excludes ferry earnings at Jersey City, N. J.
b Leased by the Boston and Maine Railroad.
c Leased by the New York Central and Hudson River Railroad.

Average rates on grain, flour, and provisions, in cents per 100 pounds, through from Chicago to European ports, by all rail to seaboard and thence by steamers, from 1895 to 1904.

Shipped to—	Articles.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Liverpool	Grain..........	32	33.5	33.6	34.35	29.72	29.48	21.47	20.85	22.68	20.19
Do.........	Sacked flour..	34	34.3	36.81	37.66	30.12	27.9	23	23.5	25.19	21.00
Do.........	Provisions....	41.81	44.91	44.4	47.15	40.5	48.84	36	36.25	41.9	36.56
Glasgow......	Grain..........	34.19	34.22	35.23	36	32.35	30.98	24.1	21.75	24.43	22.38
Do.........	Sacked flour..	36.25	36.5	39.06	39.06	31.25	31.56	24.38	22.75	25.38	23.20
Do.........	Provisions....	49.69	49.97	52.5	52.5	44.69	55.31	45.16	41.88	46.88	44.06
London........	Grain..........	33.29	33.48	34	35	30.6	31.1	23.23	21.75	23.56	21.50
Do.........	Sacked flour..	35.13	35.28	36.12	37.25	33.5	35.01	25.5	24	25.19	22.25
Do.........	Provisions....	46.03	47.15	48.14	49.69	44.14	55.87	44.75	39.06	44.06	44.06
Antwerp	.....do	48.28	49.69	51.09	52.5	47.5	51.09	46.25	41.5	49.69	48.28
Hamburg......	.....do	50	51	51	52	46	50	44	39	47	46.00
Amsterdam ..	.....do	50	52	52	52.5	47	51	45	40	42	42.00
Rotterdam ...	.....do	48	52	52	52.5	47	51	45	40	42	42.00
Copenhagen..	.....do	55.31	58.12	57.28	58.13	51.72	55.31	47.75	42	49.69	46.88
Stockholm ...	.....do	66.56	69.37	68.53	69.25	62.97	64.5	53.25	45	52.5	49.69
Stettin........	.....do	55.31	58.12	57.28	58.13	51.72	55.31	47.75	42	49.69	46.88
Bordeaux	.....do	64.13	64.13	64.13	65.75	59.12	64.12	54.25	51.25	56.25	56.25

IMPORTS AND EXPORTS OF AGRICULTURAL PRODUCTS.[a]

[Compiled by the Division of Foreign Markets, Bureau of Statistics, Department of Agriculture.]

Agricultural imports of the United States during the five years ended June 30, 1904.

Articles imported.	1900.		1901.		1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
ANIMAL MATTER.										
Animals, live:										
Cattle—										
For breeding purposes, number	1,045	$202,615	1,249	$273,728	1,928	$375,096	1,481	$225,875	684	$79,986
Other .... number	179,961	2,055,079	144,773	1,657,705	94,099	1,233,626	64,694	935,673	15,372	230,751
Total cattle .... do	181,006	2,257,694	146,022	1,931,433	96,027	1,608,722	66,175	1,161,548	16,056	310,737
Horses—										
For breeding purposes, number	1,284	357,272	1,910	714,623	2,944	1,273,607	2,803	1,191,611	2,634	1,090,596
Other .... number	1,818	239,320	1,875	271,115	1,888	303,627	2,196	344,685	2,092	369,691
Total horses .... do	3,102	596,592	3,785	985,738	4,832	1,577,234	4,999	1,536,296	4,726	1,460,287
Sheep—										
For breeding purposes, number	2,427	48,324	2,032	48,989	2,059	46,663	1,737	38,037	1,253	23,298
Other .... number	379,365	1,316,702	329,456	1,187,288	264,894	910,047	299,886	998,897	236,841	791,991
Total sheep .... do	381,792	1,365,026	331,488	1,236,277	266,953	956,710	301,623	1,036,934	238,094	815,289
All other, including fowls	....	311,638	....	325,507	....	481,865	....	799,067	....	543,296
Total live animals	....	4,530,950	....	4,478,955	....	4,624,531	....	4,533,845	....	3,129,609
Beeswax .... pounds	213,813	51,526	213,773	55,884	408,706	115,937	488,576	127,220	425,168	116,878
Bladders, other than fish	....	....	....	....	....	....	....	34,019	....	19,578
Blood, dried	....	....	....	....	....	....	....	....	....	23,671
Bones, hoofs, and horns	....	830,063	....	674,368	....	692,634	....	619,239	....	536,366
Bristles:										
Crude, unsorted .... pounds	27,140	22,330	51,539	22,310	40,537	28,446	34,239	13,069	11,241	10,976
Sorted, bunched, or prepared, pounds	2,503,018	2,130,537	1,633,036	1,707,887	1,972,572	2,018,885	3,009,806	2,641,535	2,576,615	2,356,325
Total .... pounds	2,530,158	2,152,867	1,684,575	1,730,197	2,013,109	2,047,331	3,044,045	2,654,604	2,587,856	2,367,301

[a] Forest products come within the scope of the Department of Agriculture and are included, therefore, in alphabetical order in the following tables.

Agricultural imports of the United States during the five years ended June 30, 1904—Continued.

Articles imported.	1900.		1901.		1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
ANIMAL MATTER—continued.										
Cochineal *a* ....pounds..	157,917	$31,211	114,414	$20,414	138,821	$24,865	112,714	$24,215	162,362	$64,246
Dairy products:										
Butter ....do....	49,791	9,769	93,669	19,441	453,978	80,725	207,007	51,564	154,457	34,764
Cheese ....do....	13,455,990	1,761,613	15,329,099	2,120,293	17,067,714	2,551,366	20,671,384	3,183,224	22,707,103	3,284,811
Milk	...	42,686	...	48,062	...	33,457	...	42,696	...	32,931
Total........	...	1,814,068	...	2,187,796	...	2,665,548	...	3,277,484	...	3,352,506
Eggs ....dozens..	135,038	8,741	126,520	10,515	384,070	37,432	368,482	29,757	496,825	61,458
Egg yolks	...	19,594	...	246	...	6,869	...	25,795	...	22,781
Feathers and downs, crude........	...	1,736,458	...	1,524,859	...	2,032,566	...	2,476,659	...	2,742,018
Fibers, animal:										
Silk—										
Cocoons ....pounds..	30,004	18,235	132	139	4,118	1,695	259	158	29,759	10,697
Raw, or as reeled from the cocoon ....pounds..	11,259,310	44,549,672	9,139,617	29,353,777	12,620,682	41,714,331	13,637,206	49,002,597	12,630,883	44,461,564
Waste ....do....	1,784,404	761,853	1,265,806	697,449	1,610,026	919,325	1,633,394	1,008,295	4,062,067	1,628,239
Total silk........do....	13,073,718	45,329,760	10,405,555	30,051,365	14,234,826	42,635,351	15,270,859	50,011,050	16,722,709	46,100,500
Wool and hair of the camel, goat, alpaca, and like animals—										
Class 1, clothing...pounds..	37,404,243	8,009,985	30,681,475	5,025,194	66,131,670	7,927,919	42,202,121	7,488,394	45,575,993	8,573,494
Class 2, combing ....do....	12,631,283	2,633,721	5,484,264	1,074,701	6,091,024	1,071,866	15,233,113	2,833,435	12,934,143	2,819,822
Class 3, carpet........do....	105,892,929	9,617,230	67,417,766	6,429,986	94,354,272	8,712,003	119,702,562	11,831,132	115,232,698	13,420,275
Total wool ....do....	155,928,455	20,260,936	103,583,505	12,529,881	166,576,966	17,711,788	177,137,796	22,152,961	173,742,834	24,813,591
Total animal fibers.do....	169,002,173	65,590,696	113,989,060	42,581,246	180,811,792	60,347,139	192,408,655	72,164,011	190,465,543	70,914,091
Gelatin manufactures	...	30,361	...	23,230	...	(*b*)	...	(*b*)	(*b*)	(*b*)
Glue........pounds..	5,577,082	537,492	4,540,951	473,341	4,787,762	477,036	5,560,616	602,077	5,798,330	598,546
Grease. (*See* Meat and meat products.)										
Gut	...	13,138	...	1,826	...	15,826	...	101,827	...	60,351
Hair	...	2,445,964	...	1,611,424	...	1,980,319	...	2,702,734	...	2,639,586
Hide cuttings and other glue stock..	...	1,223,521	...	1,057,931	...	696,439	...	834,421	...	854,483

Hides and skins, other than furs:										
Cattle hides ....pounds..	163,865,165	19,408,217	129,174,624	14,647,413	148,627,907	17,474,039	131,640,325	16,159,902	85,370,168	10,989,035
Goatskins ....do....	81,998,818	21,987,674	73,745,596	20,577,033	88,038,516	25,478,179	85,114,070	24,928,729	86,338,547	23,971,731
Other ....do....	100,070,795	16,539,807	77,989,617	12,995,567	89,457,680	15,054,400	102,340,303	16,942,982	103,024,752	17,045,304
Total ....do....	345,934,778	57,935,698	280,909,837	48,220,013	326,124,103	58,006,618	319,094,698	58,031,613	274,733,467	52,006,070
Honey ....gallons..	146,860	70,857	182,196	83,599	167,301	56,333	287,696	115,400	206,292	69,053
Meat and meat products:										
Meat—										
Sausages, bologna	...	95,944	...	80,605	...	109,791	...	111,647	...	121,143
Other, including meat extracts	...	365,589	...	407,003	...	464,745	...	719,250	...	814,341
Total meat	...	461,533	...	487,608	...	574,536	...	830,897	...	935,484
Meat products—										
Grease	...	779,666	...	756,453	...	981,494	...	876,246	...	1,157,923
Oils ....gallons..	18,050	3,255	59,131	12,858	161,306	29,060	261,421	50,641	171,544	34,850
Rennets	...	66,907	...	88,744	...	93,358	...	76,785	...	94,439
Sausage casings	...	646,889	...	642,212	...	754,588	...	963,495	...	885,645
Stearin ....pounds..	1,524,722	27,895	3,684,720	67,686	7,634,293	492,287	10,481,807	1,097,450	1,492,407	110,606
Other	...	106,163	...	54,667	...	380,403	...	706,802	...	30,619
Total meat products	...	1,630,775	...	1,622,620	...	2,731,190	...	3,771,419	...	2,314,062
Total meat and meat products	...	2,092,308	...	2,110,228	...	3,305,726	...	4,602,316	...	3,249,546
Oils, animal. (*See* Meat and meat products.)										
Rennets. (*See* Meat and meat products.)										
Stearin. (*See* Meat and meat products.)										
Total animal matter	...	141,084,302	...	106,825,658	...	137,133,199	...	152,957,236	...	142,828,138
VEGETABLE MATTER.										
Argols, or wine lees ....pounds..	27,339,489	2,388,693	28,598,781	2,476,482	29,276,148	2,263,588	29,966,557	2,734,027	24,571,730	2,550,223
Breadstuffs. (*See* Grain and grain products.)										
Broom corn ....tons..	549	49,612	6	618	5	553	3	288	6	392
Cider ....gallons..	2,647	2,287	4,376	3,496	8,006	7,159	4,871	4,751	5,609	5,941

[a] Classed as agricultural for the first time in 1902; the statistics for earlier years are not included in the total imports of agricultural products for 1900-1901.
[b] No longer classed as agricultural.

Agricultural imports of the United States during the five years ended June 30, 1904—Continued.

Articles imported.	1900.		1901.		1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Cocoa and chocolate:										
Cocoa—										
Crude, and leaves and shells of ....pounds..	41,746,872	$5,657,283	45,924,353	$6,472,829	51,379,396	$6,656,504	63,351,294	$7,820,087	72,277,600	$8,873,709
Prepared, or manufactured, pounds..................	1,012,368	313,561	977,003	288,840	973,970	295,921	1,004,766	292,522	1,009,082	300,409
Total cocoa....pounds..	42,759,240	5,970,844	46,901,356	6,761,669	52,353,366	6,952,425	64,356,060	8,112,609	73,286,682	9,174,118
Chocolate ....do....	1,209,012	240,141	718,848	141,892	525,221	101,536	690,824	144,832	1,784,064	426,486
Total cocoa and chocolate, pounds....................	43,968,252	6,210,985	47,620,204	6,903,561	52,878,587	7,053,961	65,046,884	8,257,441	75,070,746	9,600,604
Coffee ....pounds..	787,991,911	52,467,943	854,871,310	62,861,399	1,091,004,252	70,982,155	915,086,380	59,200,746	995,043,284	69,551,799
Coffee substitutes:										
Chicory root—										
Raw, unground ......do....	1,216,518	17,762	511,693	9,833	238,272	4,687	1,411,202	27,967	4,138,248	68,312
Roasted, ground, or otherwise prepared ...pounds..	384,957	12,941	348,597	11,098	298,671	10,451	442,311	17,493	534,267	20,175
Total chicory root, pounds................	1,601,475	30,703	860,290	20,931	536,943	15,138	1,853,513	45,460	4,672,515	88,487
Other..................pounds..	1,262,659	49,029	875,420	38,354	400,527	20,499	450,643	23,613	462,378	26,483
Total coffee substitutes, pounds	2,864,134	79,732	1,735,710	59,285	937,470	35,637	2,304,156	69,073	5,134,893	114,970
Curry and curry powder...........	....	8,770	....	7,497	....	9,010	....	9,112	....	9,955
Fibers, vegetable:										
Cotton.................pounds..	67,398,521	7,960,945	46,631,283	6,787,828	98,715,680	11,712,170	74,874,426	10,892,591	48,840,590	8,541,510
Flax.....................tons..	6,967	1,646,274	6,878	1,880,717	7,772	2,094,915	8,155	2,028,012	10,123	2,541,874
Hemp ....do....	3,400	450,269	4,057	622,814	6,054	1,013,911	4,919	821,261	5,871	869,260
Istle, or Tampico fiber....do....	5,748	475,090	2,334	163,566	7,819	495,254	14,670	1,086,682	13,622	1,199,014
Jute and jute butts.......do....	102,693	3,956,413	103,140	4,412,482	128,963	4,447,987	79,703	3,358,825	96,735	4,104,870
Manila hemp.............do....	42,624	7,172,368	43,735	7,115,446	56,453	10,555,272	61,648	11,885,510	65,666	11,423,305
Sisal grass...............do....	76,921	11,782,263	70,076	7,972,564	89,583	11,961,213	87,025	13,289,444	109,214	15,935,555
Other.....................do....	10,953	891,128	8,013	764,917	9,083	977,410	16,075	1,992,779	14,428	1,740,317
Total..........................	....	34,334,750	....	29,720,334	....	43,258,132	....	45,355,104	....	46,355,795

Flowers, natural		30,621		21,268		30,382		31,577		42,612
Forest products:										
Charcoal									231,302	14,844
Chinchona bark.......pounds	4,107,358	563,065	4,858,904	1,025,546	3,723,303	649,764	3,978,850	549,753	3,605,131	501,375
Cork wood or cork bark		1,444,825		1,729,912		1,816,107		1,737,366		1,484,405
Dyewoods, and extracts of—										
Dyewoods—										
Logwood.........tons	48,188	628,464	54,793	864,986	52,657	774,380	51,008	748,550	48,491	663,572
Other		233,998		213,812		171,120		401,849		588,934
Total dyewoods		862,462		1,078,798		945,500		1,150,399		1,252,506
Extracts and decoctions of, pounds	3,350,768	221,182	2,922,141	195,647	2,991,631	213,404	3,723,133	267,371	3,145,770	269,777
Total dyewoods and extracts of		1,083,644		1,274,445		1,158,904		1,417,770		1,522,283
Gums, not elsewhere specified—										
Arabic.............pounds	961,366	113,041	2,315,679	241,660	4,269,251	341,714	3,905,053	265,386	2,890,051	186,623
Camphor, crude......do	1,789,580	485,071	2,175,784	738,875	1,831,058	576,405	2,472,440	764,403	2,819,673	874,665
Chicle...............do	2,297,992	354,720	3,140,768	753,696	4,574,605	936,065	4,282,247	954,389	5,084,580	1,308,540
Copal, cowrie, and dammar.............pounds	23,829,342	2,598,194	18,166,296	1,923,251	20,523,109	2,261,206	27,653,928	2,938,754	20,565,507	2,127,228
Gambier, or terra japonica, pounds	38,882,940	910,639	26,813,587	824,539	28,453,802	1,162,233	42,537,348	2,034,511	27,857,055	1,251,782
Shellac............pounds	10,621,451	1,408,103	9,608,745	1,277,128	9,064,789	1,605,068	11,590,725	2,713,687	10,933,413	3,505,229
Other		1,014,936		879,990		861,492		923,517		917,815
Total		6,884,704		6,639,139		7,744,183		10,594,647		10,171,882
Hemlock bark..........cords	22,580	86,630	16,794	65,418	24,971	103,930	17,040	75,283	14,111	63,460
India rubber, gutta-percha, etc.:										
Gutta-joolatong, or East Indian gum........pounds	8,701,753	237,214	9,371,087	248,838	16,850,821	501,418	13,984,817	345,431	14,887,416	430,231
Gutta-percha........do	427,678	178,616	280,560	130,957	525,767	252,329	316,290	222,400	424,617	174,953
India rubber.........do	49,377,138	31,376,867	55,275,529	28,455,383	50,413,481	24,899,230	55,010,571	30,436,710	59,015,551	40,444,250
Total...............do	58,506,569	31,792,697	64,927,176	28,835,178	67,790,069	25,652,977	69,311,678	31,004,541	74,327,584	41,049,434
Ivory, vegetable..........do	16,073,505	243,548	13,461,461	179,735	14,699,215	165,489	17,194,434	192,093	15,740,792	229,944
Naval stores—										
Tar and pitch (of wood), barrels	2,829	13,922	2,107	11,520	1,660	8,796	1,242	6,004	1,063	6,643
Turpentine, spirits of, gallons	22,183	7,547	13,630	4,441	8,457	2,814	16,705	6,020	19,751	6,224
Total		21,469		15,961		11,610		12,024		12,867

Agricultural imports of the United States during the five years ended June 30, 1904—Continued.

Articles imported.	1900.		1901.		1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—Continued.										
Forest products—Continued.										
Palm leaf, natural		$15,128		$7,085		$10,905		$5,339		$5,610
Sumac, ground .... pounds..	10,335,980	228,177	7,339,606	133,303	9,182,917	145,776	12,858,547	187,186	18,604,644	276,891
Tanning materials, n. e. s		26,219		46,477		47,500		56,401		191,201
Wood, not elsewhere specified—										
Cabinet woods, unsawed—										
Mahogany ...... M feet..	28,228	1,572,269	32,281	1,752,612	44,795	2,361,483	48,387	2,783,679	50,370	2,690,382
Other		858,433		1,240,737		999,792		1,251,621		1,434,229
Total cabinet woods		2,430,702		2,993,349		3,361,275		4,035,300		4,124,611
Timber—										
Round, including logs, M feet	101,397	879,956	82,985	804,188	106,171	907,168	73,836	637,881	66,033	552,504
Hewn, squared, or sided, cubic feet	564,789	46,550	112,653	18,810	129,183	18,027	207,554	41,131	139,180	33,357
Total timber		926,506		822,998		925,195		679,012		585,861
Lumber—										
Boards, deals, planks, and other sawed lumber, M feet	680,226	7,475,509	490,820	6,361,423	665,603	9,271,090	720,937	10,673,317	589,232	8,878,474
Shingles .... M..	541,040	1,011,234	555,853	1,028,184	707,614	1,362,821	724,131	1,494,906	770,373	1,602,999
Other		1,342,593		1,246,509		1,380,973		1,753,532		1,545,384
Total lumber		9,829,336		8,636,116		12,014,884		13,921,755		12,026,857
All other		2,650,798		3,152,586		3,319,458		3,621,782		3,752,103
Total wood, n. e. s.		15,837,342		15,605,049		19,620,812		22,257,849		20,489,432
Wood pulp .... tons..	82,441	2,405,630	46,757	1,586,402	67,416	2,059,092	116,881	3,387,770	144,796	3,602,668
Total forest products		60,633,078		57,143,650		59,187,049		71,478,022		79,619,296
Fruit juices, n. e. s.:										
Prune juice, or prune wine, gallons	40,761	33,215	37,686	26,885	42,817	32,925	53,135	40,435	70,521	38,227

Other, including cherry juice, gallons	48,727	30,087	42,152	20,989	29,108	15,114	32,810	16,709	62,988	27,731
Total ....gallons	89,488	63,302	79,838	47,874	71,925	48,039	85,945	57,144	133,509	65,958
Fruits:										
Fresh or dried—										
Bananas	....	5,877,835	....	6,550,186	....	7,307,437	....	8,541,156	....	7,709,976
Currants ....pounds	36,251,779	916,908	16,049,198	916,994	36,238,976	1,238,756	33,878,209	743,644	38,347,649	997,430
Dates ....do	19,902,512	410,349	18,434,917	372,400	20,013,681	344,833	21,681,159	486,151	21,058,164	463,459
Figs ....do	8,812,487	513,895	9,933,871	458,513	11,087,131	487,733	16,482,142	775,917	13,178,061	660,360
Lemons ....do	160,198,056	3,666,881	148,514,614	3,516,856	164,075,309	3,320,359	152,004,213	3,079,221	171,923,221	3,659,598
Oranges ....do	68,618,938	1,087,041	50,332,914	716,457	52,742,476	784,640	56,872,070	818,780	35,893,260	525,468
Plums and prunes....do	443,457	47,700	745,974	62,880	522,478	44,077	633,819	63,218	494,105	46,976
Raisins ....do	10,309,498	531,124	3,860,836	297,631	6,683,545	399,973	6,715,675	476,844	6,867,617	355,542
Other	....	1,989,546	....	2,059,130	....	2,053,588	....	2,353,864	....	2,749,670
Total fresh or dried	....	15,041,279	....	14,951,047	....	15,981,396	....	17,338,795	....	17,168,479
Prepared or preserved	....	1,243,479	....	1,366,801	....	1,454,788	....	1,521,443	....	1,796,209
Total fruits	....	16,284,758	....	16,317,848	....	17,436,184	....	18,860,238	....	18,964,688
Ginger, preserved or pickled, pounds	429,198	17,917	340,690	17,306	660,494	28,194	569,292	23,810	230,890	13,502
Grain and grain products:										
Grain—										
Barley ....bushels	189,757	91,040	171,004	84,073	57,406	33,221	56,462	30,201	90,708	45,245
Corn (maize)............do	2,480	1,942	5,169	3,418	18,278	13,418	40,919	29,966	16,633	10,837
Oats ....do	41,523	18,360	20,735	8,995	25,812	12,085	137,416	45,899	170,882	57,802
Rye ....do	330	366	46	33	88	97	858	430	32,512	20,329
Wheat ....do	316,968	240,496	600,212	418,327	118,612	78,640	1,077,424	669,419	6,852	7,517
Total grain ....do	551,058	352,204	797,166	514,846	220,196	137,461	1,313,059	775,915	317,587	141,730
Grain products—										
Meal and flour—										
Oatmeal ....pounds	234,959	13,499	204,694	11,667	236,981	13,628	227,681	13,685	235,819	14,201
Wheat flour....barrels	717	3,771	642	3,430	420	2,610	601	4,489	46,851	164,100
Total meal and flour	....	17,270	....	15,097	....	16,238	....	18,174	....	178,301
Malt, barley ......bushels	4,399	4,127	4,580	4,635	3,019	2,929	2,468	3,029	3,465	3,250
Macaroni, vermicelli, etc., pounds	(a)	(a)	(a)	(a)	(a)	(a)	28,787,821	1,171,887	40,224,202	1,617,634
Other	....	1,023,226	....	1,078,995	....	1,380,658	....	438,963	....	613,916
Total grain products	....	1,044,623	....	1,098,727	....	1,399,825	....	1,632,053	....	2,413,101
Total grain and grain products	....	1,396,827	....	1,613,573	....	1,537,286	....	2,407,968	....	2,554,831

a Not stated.

Agricultural imports of the United States during the five years ended June 30, 1904—Continued.

Articles imported.	1900.		1901.		1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Hay ....tons..	143,890	$1,019,743	142,620	$1,128,610	48,415	$381,417	293,112	$2,238,109	114,388	$914,842
Hops ....pounds..	2,589,725	713,701	2,606,708	851,008	2,805,293	833,702	6,012,510	1,808,491	2,758,163	1,374,327
Indigo....do....	2,746,941	1,446,490	3,139,063	1,402,891	3,057,673	1,035,980	4,532,458	1,202,451	5,046,614	1,282,497
Licorice root *a*....do....	106,333,199	1,667,256	100,105,654	1,737,097	109,077,323	1,926,903	88,580,611	1,545,167	89,463,182	1,472,323
Liquors, alcoholic:										
Distilled spirits—										
Of domestic manufacture, returned ..proof gallons..	687,024	630,574	875,099	794,591	805,212	749,687	819,591	846,404	471,596	539,362
Brandy....do....	244,100	696,540	290,301	843,318	316,222	911,419	348,878	1,000,997	390,988	1,104,410
Other....do....	1,550,896	2,282,717	1,712,156	2,524,237	1,909,887	2,784,048	2,061,057	2,987,179	2,238,842	3,313,735
Total distilled spirits, proof gallons	2,482,020	3,609,831	2,877,556	4,162,149	3,031,321	4,445,154	3,229,526	4,834,580	3,101,426	4,957,507
Malt liquors—										
Unbottled ....gallons..	2,228,502	647,533	2,447,555	719,092	2,553,105	718,383	2,966,343	835,694	3,197,955	927,507
Bottled....do....	1,081,818	1,079,723	1,151,891	1,166,123	1,198,406	1,161,965	1,292,475	1,252,047	1,467,756	1,385,818
Total malt liquors.do....	3,310,320	1,727,256	3,599,446	1,885,215	3,751,511	1,880,348	4,258,818	2,087,741	4,665,711	2,313,325
Wines—										
Champagne and other sparkling, dozen quarts..	310,149	4,115,908	311,078	4,589,491	335,256	4,930,768	407,944	5,861,639	336,245	4,969,635
Still wines—										
Unbottled ....gallons..	2,533,828	1,744,736	2,785,850	1,942,322	3,300,026	2,143,433	3,753,211	2,292,297	4,007,691	2,387,018
Bottled ....dozen quarts..	315,920	1,560,851	373,832	1,687,420	397,818	1,846,937	440,869	2,095,360	471,153	2,035,217
Total still wines	....	3,305,587	....	3,629,742	....	3,990,370	....	4,387,657	....	4,422,235
Total wines....	....	7,421,495	....	8,219,236	....	8,921,138	....	10,249,296	....	9,391,870
Total alcoholic liquors..	....	12,758,582	....	14,266,600	....	15,246,640	....	17,171,617	....	16,662,702
Malt, barley. (*See* Grain and grain products.)										
Malt extract, fluid or solid....	....	4,320	....	4,863	....	3,683	....	3,008	....	2,924
Malt liquors. (*See* Liquors, alcoholic.)										

Nursery stock:										
Plants, trees, shrubs, vines, etc		7,016		463		1,172,023		1,371,588		1,493,789
Subtropical plants, etc., for propagation		965,369		1,098,469		547		1,610		2,638
Total nursery stock		972,385		1,098,932		1,172,570		1,373,198		1,496,427
Nuts:										
Almonds .... pounds	6,317,633	949,083	5,140,232	946,138	9,868,982	1,240,886	8,142,164	1,337,717	9,838,852	1,246,474
Cocoanuts		702,947		804,233		832,383		908,242		971,852
Walnuts .... pounds	(b)	(b)	(b)	(b)	(b)	(b)	12,362,567	1,106,033	23,670,761	1,729,378
Other		1,326,804		1,518,484		1,971,072		1,514,406		1,523,462
Total nuts		2,978,834		3,268,855		4,044,341		4,866,398		5,471,166
Oil cake .... pounds	208,657	1,437	448	64	2,614,059	20,740	3,827,014	30,286	1,794,873	18,592
Oil cake (substitute for india rubber)		846								
Oils, vegetable:										
Fixed or expressed—										
Olive, salad .... gallons	967,702	1,170,871	983,059	1,266,293	1,339,097	1,579,409	1,494,132	1,736,648	1,713,590	1,875,825
Other		3,290,656		3,422,170		5,046,811		7,750,712		5,952,702
Total fixed or expressed		4,461,527		4,688,463		6,626,220		9,487,360		7,828,527
Volatile, or essential		1,859,184		1,959,395		2,092,371		2,156,331		2,396,748
Total vegetable oils		6,320,711		6,647,858		8,718,591		11,643,691		10,225,275
Opium, crude .... pounds	544,938	1,123,756	583,208	1,259,726	534,189	1,216,202	516,570	1,019,909	573,055	1,255,115
Opium, prepared .... do	142,479	1,065,965	117,581	972,582	(c)	(c)	(c)	(c)	(c)	(c)
Rice, rice meal, etc.:										
Rice .... do	93,648,451	1,904,915	74,598,061	1,588,044	75,674,776	1,596,210	78,317,310	1,732,238	75,323,157	1,869,338
Rice flour, rice meal, and broken rice .... pounds	23,031,440	374,121	42,601,649	736,854	81,984,118	1,330,711	91,338,974	1,329,235	78,898,615	1,204,092
Total .... do	116,679,891	2,279,036	117,199,710	2,324,898	157,658,894	2,926,921	169,656,284	3,061,473	154,221,772	3,073,430
Sago, tapioca, etc		411,029		443,333		545,938		618,221		695,922
Seeds:										
Flaxseed, or linseed ... bushels	67,379	94,126	1,631,726	2,098,207	477,157	724,082	129,089	194,024	213,270	201,224
Other		1,700,922		1,940,987		2,528,070		2,637,255		3,386,245
Total		1,795,048		4,039,194		3,252,152		2,831,279		3,587,469

a Classed as agricultural for the first time in 1902; the statistics for earlier years are not included in the total agricultural imports for 1900–1901.
b Not stated.
c No longer classed as agricultural.

Agricultural imports of the United States during the five years ended June 30, 1904—Continued.

Articles imported.	1900.		1901.		1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Spices:										
Unground—										
Nutmegs ....pounds..	1,590,811	$351,383	1,836,417	$360,889	1,841,614	$339,685	2,365,624	$444,643	1,498,600	$288,388
Pepper, black or white, pounds....................	13,085,333	1,283,635	16,081,849	1,806,167	16,046,179	1,752,345	21,832,675	2,296,221	18,615,186	2,069,051
Other.............pounds..	19,652,762	1,376,243	13,506,848	1,001,482	15,134,481	1,146,246	22,464,192	1,590,778	17,745,806	1,469,587
Total unground....do....	34,328,906	3,011,261	31,425,114	3,168,538	33,022,274	3,238,276	46,662,491	4,331,642	37,859,592	3,827,026
Ground..................do....	4,516,709	390,004	3,786,623	394,571	4,460,841	446,966	4,538,688	483,483	5,414,804	538,982
Total spices ....do....	38,845,615	3,401,265	35,211,737	3,563,109	37,483,115	3,685,242	51,201,179	4,815,125	43,274,396	4,366,008
Spirits distilled. (*See* Liquors, alcoholic.)										
Starch....................pounds..	11,767,924	222,296	7,302,501	179,340	11,714,931	235,645	10,540,905	205,949	7,430,383	191,450
Straw.........................tons..	5,495	15,750	9,633	35,816	2,986	11,723	3,303	12,832	10,838	81,794
Sugar and molasses:										
Molasses...............gallons..	7,025,068	890,524	11,453,156	1,123,923	14,391,215	1,037,696	17,240,399	1,124,710	18,828,530	1,018,198
Sugar—										
Raw—										
Beet...........pounds..	701,539,452	14,800,609	908,683,078	20,028,575	255,030,219	4,202,044	87,130,805	1,223,023	2,414,454	50,525
Cane ....do....	3,305,087,796	85,059,367	2,956,586,102	67,507,439	2,685,792,937	48,684,775	4,075,635,121	69,740,051	3,681,904,214	71,359,114
Total raw ......do....	4,006,627,248	99,859,976	3,865,269,180	87,536,014	2,940,823,156	52,886,819	4,162,765,926	70,963,074	3,684,318,668	71,409,639
Refined ....do....	11,459,282	390,998	109,736,660	2,951,786	91,092,719	2,174,278	53,342,180	1,125,899	16,304,945	506,114
Total sugar.........do....	4,018,086,530	100,250,974	3,975,005,840	90,487,800	3,031,915,875	55,061,097	4,216,108,106	72,088,973	3,700,623,613	71,915,753
Total sugar and molasses	....	101,141,498	....	91,611,723	....	56,098,793	....	73,213,683	....	72,933,951
Tea.........................pounds..	84,845,107	10,558,110	89,806,453	11,017,876	75,579,125	9,390,128	108,574,905	15,659,229	112,905,541	18,229,310
Tobacco:										
Wrapper..................do....	5,561,068	5,122,359	6,574,586	5,940,857	5,729,879	5,084,606	6,314,359	4,669,932	7,387,390	5,641,124
Filler and other leaf.....do....	14,058,559	8,174,864	20,276,667	10,349,530	23,698,958	10,127,065	27,702,597	12,564,983	23,775,246	11,298,363
Total........................	19,619,627	13,297,223	26,851,253	16,290,387	29,428,837	15,211,671	34,016,956	17,234,915	31,162,636	16,939,487

Vanilla beans ....pounds..	255,966	1,209,334	248,988	875,229	361,739	859,399	521,689	1,032,654	550,328	1,424,647
Vegetables:										
Fresh or dried—										
Beans and dried pease, bushels..................	967,031	1,049,443	1,099,640	1,306,405	881,966	1,152,177	1,088,665	1,420,334	978,187	1,223,309
Onions ....bushels..	546,798	357,901	774,042	509,552	796,316	608,673	925,599	699,657	1,171,242	914,413
Potatoes ....do....	155,861	147,349	371,911	224,759	7,656,162	3,160,801	358,505	238,445	3,166,581	1,870,004
Other		371,963		366,971		536,581		497,666		780,761
Total fresh or dried		1,926,656		2,407,687		5,458,232		2,856,102		4,788,487
Prepared or preserved—										
Pickles and sauces..........		306,223		388,486		480,342		537,356		646,858
Other		702,198		923,506		1,101,261		1,187,897		1,573,257
Total prepared or preserved..................		1,008,421		1,311,992		1,581,603		1,725,253		2,220,115
Total vegetables		2,935,077		3,719,679		7,039,835		4,581,355		7,008,602
Vinegar ....gallons..	122,479	30,724	135,883	34,222	168,195	45,754	152,524	42,656	181,294	46,856
Wafers, unmedicated		15,629		18,054		17,108		19,111		20,327
Wines. (*See* Liquors, alcoholic.)										
Total vegetable matter, including forest products.....		400,321,142		399,392,693		394,985,456		446,198,133		398,226,009
Total vegetable matter, excluding forest products.....		339,688,064		342,249,043		335,798,407		374,720,111		318,606,713
Total agricultural imports, including forest products		541,405,430		506,218,351		532,118,655		599,155,369		541,054,147
Total agricultural imports, excluding forest products		480,772,366		449,074,701		472,931,606		527,677,347		461,434,851

Agricultural exports (domestic) of the United States during the five years ended June 30, 1904.

Articles exported.	1900.		1901.		1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	alue.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
ANIMAL MATTER.										
Animals, live:										
Cattle .... number..	397,286	$30,635,153	459,218	$37,566,980	392,884	$29,902,212	402,178	$29,848,936	593,409	$42,256,291
Hogs .... do....	51,180	391,813	22,318	238,465	8,368	88,330	4,031	40,923	6,345	53,780
Horses .... do....	64,722	7,612,616	82,250	8,873,845	103,020	10,048,046	34,007	3,152,159	42,001	3,189,100
Mules .... do....	43,369	3,919,478	34,405	3,210,267	27,586	2,692,298	4,294	521,725	3,658	412,971
Sheep .... do....	125,772	733,477	297,925	1,933,000	358,720	1,940,060	176,961	1,067,860	301,313	1,954,604
Other, including fowls	....	289,494	....	236,319	....	200,738	....	149,590	....	111,129
Total	....	43,585,031	....	52,058,876	....	44,871,684	....	34,781,193	....	47,977,875
Beeswax .... pounds..	319,379	91,913	140,276	39,464	125,283	36,541	70,811	21,337	55,631	16,545
Bones, hoofs, horns, and horn tips, strips, and waste	....	199,194	....	218,680	....	163,180	....	193,817	....	208,523
Bristles	....	1,446	....	3,968	....	17	....	515	....	1,808
Dairy products:										
Butter .... pounds..	18,266,371	3,143,509	23,243,526	4,014,905	16,002,169	2,885,609	8,896,166	1,604,327	10,717,824	1,768,184
Cheese .... do....	48,419,353	4,943,609	39,813,517	3,950,999	27,203,184	2,745,597	18,987,178	2,250,229	23,335,172	2,452,239
Milk	....	1,139,402	....	1,437,818	....	1,473,564	....	921,026	....	1,367,794
Total	....	9,226,520	....	9,403,722	....	7,104,770	....	4,775,582	....	5,588,217
Eggs .... dozens..	5,920,727	984,081	3,692,875	676,232	2,717,990	528,679	1,517,189	325,571	1,776,632	396,408
Egg yolks	....	883	....	1,610	....	14,700	....	48,108	....	28,294
Feathers	....	280,309	....	327,966	....	239,756	....	141,257	....	157,035
Fibers, animal:										
Silk waste .... pounds..	285,640	53,851	53,398	9,138	81,477	9,759	149,400	19,968	227,139	30,814
Wool .... do....	2,200,309	387,239	199,565	26,017	123,278	13,369	518,919	71,818	319,750	37,171
Total .... do....	2,485,949	441,090	252,963	35,155	204,755	23,128	668,319	91,786	546,889	67,985
Glue .... do....	2,349,014	225,844	2,703,400	254,447	2,907,632	284,413	2,569,164	253,768	2,656,057	258,511
Grease. (*See* Meat and meat products.)										
Hair	....	676,688	....	674,881	....	633,337	....	616,133	....	724,514
Hides and skins other than furs, pounds	7,486,256	804,674	11,161,749	1,064,952	9,372,747	906,504	12,859,549	1,224,409	32,727,643	3,246,887
Honey	....	30,191	....	55,574	....	106,112	....	64,220	....	69,317

Meat and meat products:										
Meat—										
Beef—										
Fresh..........pounds..	529,078,609	29,643,830	351,748,333	31,851,361	301,824,473	29,045,056	254,795,963	25,013,323	299,579,671	26,841,586
Cured—										
Salted or pickled, pounds............	47,306,513	2,697,340	55,312,632	3,145,219	48,632,727	3,031,027	52,801,220	3,814,671	57,584,710	3,260,475
Other......pounds..	2,319,165	197,051	789,285	72,677	818,382	72,836	1,126,032	102,184	269,112	20,542
Total cured, pounds..........	49,625,678	2,894,391	56,101,917	3,217,896	49,451,109	3,103,863	53,927,252	3,916,855	57,853,822	3,281,017
Canned........pounds..	55,553,745	5,233,982	53,445,521	5,307,501	66,645,838	6,646,130	76,307,114	7,916,928	57,468,338	5,882,888
Total beef......do....	434,258,032	37,772,203	461,295,771	40,376,753	417,921,420	38,795,049	385,030,329	36,847,106	414,901,831	36,005,491
Pork—										
Fresh............do....	25,946,905	1,925,772	30,728,586	2,424,537	44,171,674	3,652,464	20,966,113	2,035,491	18,633,820	1,669,818
Cured—										
Bacon ....do....	512,153,729	38,975,915	456,122,741	37,499,026	383,150,624	35,449,797	207,336,000	22,178,525	249,665,941	24,446,752
Hams.........do....	196,414,412	20,416,367	216,571,803	22,842,778	227,653,232	25,222,744	214,183,365	25,712,633	194,948,864	22,293,867
Salted or pickled, pounds............	133,199,683	8,243,797	138,643,611	9,926,633	115,896,275	10,117,562	95,287,374	9,959,762	112,224,861	9,527,388
Total cured, pounds........	841,767,824	67,636,079	811,338,155	70,268,437	726,700,131	70,790,103	516,806,739	57,850,920	556,839,666	56,268,007
Canned........pounds..	8,496,074	658,402	8,945,594	708,381	9,603,882	832,910	13,590,897	1,369,687	9,479,312	963,321
Total pork......do....	876,210,803	70,220,253	851,012,335	73,401,355	780,475,687	75,275,477	551,363,749	61,256,098	584,952,798	58,901,146
Mutton...............do....	773,760	64,313	691,121	46,643	430,351	37,067	6,144,020	532,476	465,255	40,618
Poultry and game..........	....	463,905	....	1,070,190	....	856,801	....	1,079,056	....	1,009,304
Sausage and sausage meat, pounds..................	(a)	(a)	9,799,106	923,974	7,137,297	726,437	5,264,648	585,088	5,562,349	602,528
Canned meat, n. e. s........	....	1,724,064	....	1,556,671	....	1,801,385	....	1,831,940	....	2,254,235
Total meat................	....	110,244,738	....	117,375,591	....	117,492,216	....	102,131,704	....	98,813,322
Meat products—										
Grease, grease scraps, and other soap stock	....	2,944,322	....	3,339,948	....	2,610,925	....	2,926,565	....	3,311,777
Lard...............pounds..	661,813,663	41,939,164	611,357,514	46,560,148	556,840,222	52,375,864	490,755,821	50,854,504	561,302,643	46,347,520
Lard compounds.....do....	25,852,685	1,475,064	23,359,966	1,449,878	36,201,744	2,687,653	46,130,004	3,607,542	53,603,545	3,581,813

a Not stated.

Agricultural exports (domestic) of the United States during the five years ended June 30, 1904—Continued.

Articles exported.	1900. Quantity.	1900. Value.	1901. Quantity.	1901. Value.	1902. Quantity.	1902. Value.	1903. Quantity.	1903. Value.	1904. Quantity.	1904. Value.
ANIMAL MATTER—continued.										
Meat and meat products—Cont'd.										
Meat products—Continued.										
Oils—										
Lard oil ....gallons..	738,724	$337,260	766,783	$438,645	460,035	$327,794	356,658	$306,334	376,826	$244,499
Oleo oil........pounds..	146,739,681	10,503,856	161,651,413	11,846,373	138,546,088	12,254,969	126,010,339	11,981,888	165,183,839	12,873,558
Other..........gallons..	381,161	172,568	574,209	258,406	352,201	201,535	221,669	159,505	452,481	273,481
Total oils............	....	11,013,684	....	12,543,424	....	12,784,298	....	12,447,727	....	13,391,538
Oleomargarine (imitation butter)..........pounds..	4,256,067	416,544	4,990,699	484,501	5,721,254	601,521	7,645,652	798,273	6,137,251	605,874
Sausage casings............	....	2,307,571	....	2,778,854	....	1,795,044	....	1,964,524	....	2,353,167
Tallow ....pounds..	89,030,943	4,398,204	77,166,889	3,848,561	34,065,758	1,924,577	27,368,924	1,623,852	76,924,174	3,801,302
Other	....	3,941,394	....	3,212,009	....	3,624,764	....	2,101,785	....	2,062,813
Total meat products	....	68,435,947	....	74,217,323	....	78,404,646	....	76,324,772	....	75,455,804
Total meat and meat products	....	178,680,685	....	191,592,914	....	195,896,862	....	178,456,536	....	174,269,126
Oils, animal. (*See* Meat and meat products.)										
Quills	....	1,105	....	8,281	....	6,168	....	3,976	....	23,16
Silk waste. (*See* Fibers, animal.)										
Wool. (*See* Fibers, animal.)										
Total animal matter	....	235,239,654	....	256,416,722	....	250,815,851	....	220,998,208	....	233,034,209
VEGETABLE MATTER.										
Breadstuffs. (*See* Grain and grain products.)										
Broom corn	....	182,520	....	237,863	....	244,358	....	211,253	....	226,179
Broom root (rice root)	....	6,140	....	1,708	....	1,798	....	....	....	....
Cider ....gallons..	483,367	64,283	462,048	61,132	121,006	21,869	598,119	84,084	714,476	103,314
Cocoa, ground or prepared, and chocolate	....	231,509	....	333,036	....	166,245	....	213,476	....	250,034
Coffee:										
Green or raw ....pounds..	(*a*)	(*a*)	497,559	72,584	27,088,368	3,209,946	29,233,837	3,295,968	32,208,497	3,656,943
Roasted or prepared......do....	(*a*)	(*a*)	(*a*)	(*a*)	443,985	71,152	535,108	89,899	405,893	64,516
Total ....do....	(*a*)	(*a*)	....	....	27,532,353	3,281,098	29,768,945	3,385,867	32,614,390	3,721,459

Cotton:										
Sea island .... bales	46,308	2,985,378	29,305	2,237,558	31,771	2,486,907	51,688	4,038,370	34,776	3,154,376
Sea island .... pounds ..	18,199,967		11,373,867		12,231,680		20,205,080		13,254,404	
Upland .... bales	6,043,836	238,847,359	6,479,145	311,435,885	6,841,921	288,164,912	6,886,591	312,142,059	5,974,418	367,656,870
Upland .... pounds ..	3,032,383,221		3,319,516,5 1		3,488,547,083		3,522,837,942		3,049,938,356	
Linters .... pounds ..	25,642,400	1,156,241	28,171,912	1,431,604	28,195,873	946,537	26,098,947	884,842	26,663,146	1,238,018
Total .... do	3,126,225,588	242,988,978	3,359,062,360	315,105,047	3,528,974,636	291,593,356	3,569,141,969	317,065,271	3,089,855,906	372,049,264
Flowers, cut	....	4,163	....	1,787	....	4,788	....	5,290	....	5,076
Forest products:										
Bark, and extracts of, for tanning	....	376,742	....	386,238	....	288,012	....	239,786	....	291,783
Charcoal	....	1,598	....	4,164	....	4,929	....	5,118	....	22,646
Naval stores:										
Rosin .... barrels ..	2,369,118	3,796,367	2,820,815	4,742,457	2,535,962	4,202,104	2,396,498	4,817,205	2,585,108	6,621,870
Tar .... do	36,535	77,082	32,135	77,669	23,236	55,854	18,622	50,802	15,644	44,944
Turpentine and pitch, barrels	20,246	45,823	18,391	45,795	18,370	44,356	15,972	36,379	13,177	32,253
Turpentine, spirits of, gallons	18,090,582	8,554,922	20,240,851	7,715,029	19,177,788	7,431,248	16,378,787	8,014,322	17,202,808	9,446,155
Total	....	12,474,194	....	12,580,950	....	11,733,562	....	12,918,708	....	16,145,222
Wood:										
Timber—										
Round	....	5,020,471	....	3,608,092	....	3,343,908	....	4,506,728	....	4,473,297
Hewn .... cubic feet ..	4,416,741	785,305	4,624,698	802,528	5,388,439	1,030,687	3,291,498	787,082	3,788,740	881,557
Sawed .... M feet ..	473,542	5,763,390	533,920	6,376,686	412,750	5,225,003	530,659	7,462,111	558,690	8,472,355
Total timber	....	11,569,166	....	10,787,306	....	9,599,598	....	12,755,921	....	13,827,209
Lumber—										
Boards, deals, and planks .... M feet ..	1,046,758	17,731,696	1,101,815	20,106,242	942,814	16,978,322	1,065,771	20,965,828	1,426,784	28,603,355
Joists and scantling, M feet	41,013	550,495	41,496	572,704	37,885	472,384	46,894	647,920	60,119	875,062
Shingles .... M ..	86,118	169,667	39,255	89,588	33,224	86,799	38,211	86,245	28,484	82,377
Shooks—										
Box	....	587,047	....	590,271	....	700,035	....	779,777	....	869,802
Other .... number ..	773,019	728,753	714,651	882,438	788,241	798,884	566,205	829,248	533,182	795,595
Total shooks	....	1,315,800	....	1,472,709	....	1,498,919	....	1,609,025	....	1,665,397

a Not stated.

Agricultural exports (domestic) of the United States during the five years ended June 30, 1904—Continued.

Articles exported.	1900.		1901.		1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Forest products—Continued.										
Wood—Continued.										
Lumber—Continued.										
Staves and heading—										
Heading	....	$78,146	....	$137,961	....	$123,376	....	$134,383	....	$170,874
Staves ....number	49,011,533	4,337,418	47,363,262	3,757,048	46,998,512	3,830,432	55,879,010	4,740,680	47,420,095	4,032,344
Total staves and heading	....	4,415,564	....	3,895,009	....	3,953,808	....	4,875,063	....	4,203,218
Other	....	3,613,190	....	4,422,384	....	3,572,328	....	3,732,782	....	3,190,687
Total lumber	....	27,796,412	....	30,558,636	....	26,562,560	....	31,916,363	....	38,620,096
Total wood	....	39,365,578	....	41,345,942	....	36,162,158	....	44,672,284	....	52,447,305
Wood alcohol *a* proof gallons	540,799	320,306	919,504	476,582	626,925	338,619	833,629	452,892	1,194,466	585,359
Wood pulp ....pounds	28,554,801	458,463	61,528,437	1,051,867	38,348,632	740,103	22,464,472	445,228	30,230,820	593,474
Total forest products	....	52,676,575	....	55,369,161	....	48,928,764	....	58,281,124	....	70,085,789
Fruits:										
Fresh or dried—										
Apples, fresh ......barrels	526,636	1,444,655	883,673	2,058,964	459,719	1,628,886	1,656,129	4,381,801	2,018,262	5,446,473
Apples, dried ......pounds	34,964,010	2,247,851	28,309,023	1,510,581	15,664,468	1,190,593	39,646,297	2,378,635	48,301,665	2,791,421
Apricots, dried ......do	(*b*)	(*a*)	(*a*)	(*a*)	1,928,367	178,143	9,190,081	713,887	7,205,686	608,511
Oranges	....	271,468	....	436,560	....	420,835	....	465,397	....	739,593
Prunes ....pounds	25,922,371	1,646,332	10,021,564	589,113	23,358,849	1,404,422	66,385,215	3,512,507	73,146,214	3,410,497
Raisins ....do	2,415,456	139,689	3,512,164	218,715	2,323,274	149,216	4,280,028	284,530	4,020,418	281,402
Other	....	2,545,451	....	2,716,269	....	2,153,050	....	4,215,034	....	4,317,910
Total fresh or dried	....	8,295,446	....	7,530,202	....	7,125,145	....	15,951,791	....	17,595,807
Preserved—										
Canned	....	3,127,278	....	3,006,109	....	1,195,635	....	1,739,571	....	2,637,002
Other	....	63,448	....	71,597	....	94,323	....	66,757	....	115,490
Total preserved	....	3,190,726	....	3,077,706	....	1,289,958	....	1,806,328	....	2,752,492
Total fruits	....	11,486,172	....	10,607,908	....	8,415,103	....	17,758,119	....	20,348,299

Ginseng ....pounds..	169,901	833,710	149,069	801,672	151,063	856,515	151,985	796,008	131,882	851,820
Glucose and grape sugar ....do.....	221,901,459	3,600,139	204,209,974	3,113,898	130,419,611	2,319,286	126,239,981	2,460,022	152,768,716	2,949,545
Grain and grain products:										
Grain—										
Barley ....bushels..	23,661,662	11,216,694	6,293,207	2,883,565	8,714,268	3,995,303	8,429,141	4,662,544	10,881,627	6,292,914
Buckwheat...........do....	426,822	254,847	123,540	79,120	719,615	449,917	117,953	75,713	31,006	19,827
Corn (maize).........do....	209,348,284	85,206,400	177,817,965	82,527,983	26,636,552	16,185,673	74,833,237	40,540,637	55,858,965	30,071,334
Oats....................do....	41,369,415	12,504,654	37,146,812	11,765,330	9,971,139	4,153,238	4,613,809	1,850,728	1,153,714	475,362
Rye ....do....	2,355,792	1,442,055	2,326,882	1,321,979	2,697,863	1,581,491	5,422,731	3,143,910	765,108	440,980
Wheat.................do....	101,950,389	73,237,080	132,060,667	96,771,743	154,856,102	112,875,222	114,181,420	87,795,104	44,230,169	35,850,318
Total grain.........do....	379,112,364	183,861,730	355,769,073	195,349,720	203,595,539	139,240,844	207,598,291	138,068,636	112,920,589	73,150,735
Grain products—										
Meal and flour—										
Corn meal .....barrels..	943,782	2,148,410	896,877	2,065,432	348,034	1,046,643	451,506	1,382,127	590,774	1,691,669
Oatmeal.......pounds..	66,229,950	1,547,900	92,198,138	2,308,649	59,516,512	1,617,298	67,823,935	1,839,106	14,526,477	463,062
Rye flour ......barrels..	4,370	14,757	3,105	10,860	2,369	8,403	3,757	12,818	3,160	11,302
Wheat flour ......do....	18,699,194	67,760,886	18,650,979	69,459,296	17,759,203	65,661,974	19,716,484	73,756,404	16,994,432	68,894,836
Total meal and flour..	....	71,471,953	....	73,844,237	....	68,334,318	....	76,990,455	....	71,060,869
Bran, middlings, and mill feed ....tons..	166,604	2,638,719	79,358	1,383,246	48,980	932,595	49,513	945,053	19,193	366,213
Malt...............bushels..	296,742	215,198	357,947	250,099	401,375	266,894	347,147	252,801	438,580	315,676
Malt sprouts	....	62,266	....	(b)	....	(b)	....	(b)	(b)	(b)
Distillers and brewers' grains and malt sprouts, tons......................	(b)	(b)	59,136	992,836	66,846	1,157,636	73,104	1,320,065	56,038	1,062,336
Breadstuff preparations—										
Bread and biscuit, pounds................	18,329,815	938,513	12,420,325	606,811	11,641,411	604,136	11,104,575	589,536	12,071,261	635,133
Other	....	2,362,715	....	2,832,930	....	2,205,018	....	2,667,409	....	2,172,571
Total breadstuff preparations	....	3,301,228	....	3,439,741	....	2,809,154	....	3,256,945	....	2,807,704
All other..................	....	1,470,448	....	584,838	....	629,797	....	661,131	....	602,521
Total grain products......	....	79,159,812	....	80,494,997	....	74,160,394	....	83,426,450	....	76,215,319
Total grain and grain products................	....	263,021,542	....	275,844,717	....	213,401,238	....	221,495,086	....	149,366,054

a Classed as agricultural for the first time in 1904; the statistics for earlier years are not included in the total domestic exports of forest products for 1900–1903.
b Not stated.

Agricultural exports (domestic) of the United States during the five years ended June 30, 1904—Continued.

Articles exported.	1900. Quantity.	1900. Value.	1901. Quantity.	1901. Value.	1902. Quantity.	1902. Value.	1903. Quantity.	1903. Value.	1904. Quantity.	1904. Value.
VEGETABLE MATTER—continued.										
Grasses, dried	....	$20,148	....	$18,295	....	$18,001	....	$15,294	....	$8,762
Hay .... tons	72,716	992,741	89,364	1,476,870	153,431	2,580,622	50,974	828,483	60,730	1,052,705
Hops .... pounds	12,639,474	1,707,660	14,963,676	2,466,515	10,715,151	1,550,657	7,794,705	1,909,951	10,985,988	2,116,180
Lard compounds. (*See* Meat and meat products.)										
Liquors, alcoholic:										
Distilled spirits—										
Alcohol, including cologne spirits, proof galls	177,974	59,277	237,509	97,633	367,538	220,453	120,697	23,510	587,549	112,291
Brandy .... do	80,259	83,698	15,323	28,176	24,077	30,174	18,117	19,213	70,193	44,119
Rum .... do	670,410	903,808	1,076,711	1,468,110	1,095,401	1,425,920	1,096,719	1,458,393	757,227	994,959
Whisky—										
Bourbon .... do	863,241	764,860	525,372	687,969	611,518	638,061	169,396	203,137	231,540	254,693
Rye .... do	91,721	121,241	160,357	251,583	155,046	275,717	104,236	223,480	127,535	217,551
Total whisky, proof gallons	954,962	886,101	685,729	939,552	766,564	913,778	273,632	426,617	359,075	472,244
Other .... do	18,585	24,921	23,562	44,670	76,384	82,950	48,014	62,358	47,402	67,854
Total distilled spirits, proof gallons	1,902,190	1,957,805	2,038,834	2,578,141	2,329,964	2,673,275	1,557,179	1,990,091	1,821,446	1,691,467
Malt liquors—										
Unbottled .... gallons	761,411	194,157	333,666	79,508	417,025	90,769	400,072	95,758	382,346	84,687
Bottled .... dozen quarts	1,578,240	1,945,059	1,351,779	1,643,517	822,899	1,199,293	759,027	1,082,982	540,301	769,432
Total malt liquors	....	2,139,216	....	1,723,025	....	1,290,062	....	1,178,740	....	854,119
Wines—										
Unbottled .... gallons	1,408,859	575,665	1,117,858	461,560	929,900	407,345	678,150	290,552	896,643	403,557
Bottled .... dozen quarts	9,854	49,927	9,901	43,013	10,952	42,980	5,232	24,624	6,066	33,136
Total wines	....	625,592	....	504,573	....	450,325	....	315,176	....	436,693
Total alcoholic liquors	....	4,722,613	....	4,805,739	....	4,413,662	....	3,484,007	....	2,982,279

Malt. (*See* Grain and grain products.)										
Malt liquors. (*See* Liquors, alcoholic.)										
Malt sprouts. (*See* grain and grain products.)										
Nursery stock	....	107, 172	....	134, 961	....	132, 027	....	158, 959	....	287, 880
Nuts	....	156, 490	....	218, 743	....	304, 241	....	299, 558	....	330, 366
Oil cake and oil-cake meal:										
Corn .... pounds..	4, 888, 776	48, 783	12, 703, 209	131, 774	14, 740, 498	164, 056	8, 093, 222	95, 568	14, 014, 885	169, 921
Cotton-seed .... do....	1, 148, 704, 342	11, 229, 188	1, 258, 687, 317	13, 119, 968	1, 050, 466, 246	12, 271, 009	1, 100, 392, 988	12, 732, 497	820, 349, 073	9, 134, 088
Flaxseed, or linseed ...... do....	483, 130, 182	5, 528, 331	455, 154, 860	5, 471, 930	582, 886, 875	7, 508, 133	570, 908, 149	7, 011, 214	668, 868, 722	7, 765, 169
Total .... do....	1, 631, 723, 300	16, 806, 302	1, 726, 545, 386	18, 723, 672	1, 648, 093, 619	19, 943, 198	1, 679, 394, 359	19, 839, 279	1, 503, 232, 680	17, 069, 178
Oils, vegetable:										
Fixed or expressed—										
Corn .... gallons..	4, 383, 926	1, 351, 867	4, 808, 545	1, 831, 980	4, 266, 398	1, 769, 370	3, 788, 035	1, 467, 493	3, 222, 875	998, 613
Cotton-seed .... do....	46, 902, 390	14, 127, 538	49, 356, 741	16, 541, 321	33, 042, 848	12, 992, 393	35, 642, 994	14, 211, 244	29, 013, 743	10, 717, 280
Linseed .... do....	103, 494	54, 148	99, 919	66, 653	102, 116	68, 617	182, 330	98, 116	336, 419	147, 721
Other	....	554, 781	....	363, 056	....	220, 372	....	169, 796	....	189, 451
Total fixed or expressed	....	16, 088, 334	....	18, 803, 010	....	15, 050, 752	....	15, 946, 649	....	12, 053, 065
Volatile, or essential—										
Peppermint .... pounds..	89, 558	90, 298	60, 166	63, 672	36, 301	54, 898	13, 033	34, 943	42, 939	124, 728
Other	....	166, 424	....	169, 004	....	202, 983	....	252, 770	....	440, 588
Total volatile, or essential	....	256, 722	....	232, 676	....	257, 881	....	287, 713	....	565, 316
Total vegetable oils	....	16, 345, 056	....	19, 035, 686	....	15, 308, 633	....	16, 234, 362	....	12, 618, 381
Rice, rice meal, etc.:										
Rice .... pounds..	12, 947, 009	500, 364	1, 078, 958	42, 807	615, 036	29, 707	532, 092	27, 048	2, 380, 418	88, 465
Rice bran, meal, and polish, pounds	28, 119, 408	167, 023	24, 448, 888	143, 922	28, 976, 238	228, 010	19, 218, 356	122, 589	26, 741, 345	200, 263
Total .... pounds..	41, 066, 417	667, 387	25, 527, 846	186, 729	29, 591, 274	257, 717	19, 750, 448	149, 637	29, 121, 763	288, 728
Rice root. (*See* Broom root.)										
Root beer .... dozen quarts..	3, 439	4, 661	1, 751	2, 018	712	1, 014	949	834	456	455
Roots, herbs, and barks, n. e. s.	....	237, 527	....	275, 150	....	290, 692	....	320, 122	....	266, 809
Seeds:										
Cotton .... pounds..	49, 855, 238	346, 230	43, 829, 257	366, 953	56, 403, 344	509, 627	51, 622, 370	532, 732	12, 859, 756	141, 174
Flaxseed, or linseed ... bushels..	2, 743, 266	3, 475, 417	2, 755, 683	4, 319, 102	3, 874, 033	6, 031, 887	4, 128, 130	5, 698, 492	758, 379	820, 668

Agricultural exports (domestic) of the United States during the five years ended June 30, 1904—Continued.

Articles exported.	1900.		1901.		1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Seeds—Continued.										
Grass seed—										
Clover .... pounds..	32,069,371	$2,379,372	11,998,674	$1,063,506	7,256,573	$594,733	15,522,527	$1,549,687	6,440,618	$600,626
Timothy .... do....	15,078,186	505,758	7,275,806	296,640	5,966,986	373,046	18,289,917	853,829	12,672,676	480,946
Other	....	165,063	....	144,948	....	315,556	....	581,773	....	299,649
Total grass seed	....	3,050,193	....	1,505,094	....	1,283,335	....	2,985,289	....	1,381,221
All other seeds	....	165,142	....	193,666	....	202,975	....	238,770	....	240,262
Total seeds	....	7,036,982	....	6,384,815	....	8,027,824	....	9,455,283	....	2,583,325
Spices	....	19,131	....	20,204	....	23,471	....	36,787	....	28,521
Spirits, distilled. (*See* Liquors, alcoholic.)										
Starch .... pounds..	124,935,963	2,604,362	102,800,725	2,005,865	28,183,967	656,705	27,759,599	832,943	57,185,739	1,340,282
Straw	....	4,200	....	5,328	....	5,092	....	1,747	....	4,607
Sugar, molasses, and sirup:										
Molasses .... gallons..	3,892,374	434,585	2,495,638	291,063	2,911,509	416,470	3,413,387	492,260	3,819,139	592,288
Sirup .... do....	11,139,770	1,682,202	15,092,321	2,235,014	14,865,744	2,048,561	12,265,295	1,714,899	12,901,957	1,846,563
Sugar—										
Raw .... pounds..	322,252	11,262	147,221	6,056	359,402	14,089	99,101	3,545	113,977	3,427
Refined .... do....	22,192,351	1,004,135	8,727,639	437,523	7,213,050	292,715	10,421,055	358,537	15,304,560	528,616
Total sugar .... do....	22,514,603	1,015,397	8,874,860	443,579	7,572,452	306,804	10,520,156	362,082	15,418,537	532,043
Total sugar, molasses, and sirup	....	3,132,184	....	2,969,656	....	2,771,835	....	2,569,241	....	2,970,894
Teasels	....	21,882	....	25,079	....	23,161	....	34,258	....	23,459
Tobacco:										
Leaf .... pounds..	334,604,210	29,163,086	306,900,934	27,475,466	291,369,700	26,881,641	357,496,342	34,972,033	305,382,128	29,464,732
Stems and trimmings ..... do....	10,051,487	259,285	8,886,848	181,009	9,637,665	222,355	10,687,742	278,860	6,589,703	176,080
Total .... do	344,655,697	29,422,371	315,787,782	27,656,475	301,007,365	27,103,996	368,184,084	35,250,893	311,971,831	29,640,812

Vegetables:										
Fresh or dried—										
Beans and peas....bushels..	617, 355	983, 401	468, 670	862, 088	324, 481	636, 345	232, 841	530, 875	248, 805	546, 479
Onions ....do....	171, 636	143, 256	165, 391	144, 030	113, 531	117, 019	145, 509	116, 624	144, 764	116, 104
Potatoes..............do....	809, 472	626, 791	741, 483	518, 621	528. 484	564, 550	843, 075	552, 533	484, 042	436, 135
Total fresh or dried, bushels	1, 598, 463	1, 753, 448	1, 375, 544	1, 524, 739	966, 496	1, 317, 914	1, 221, 425	1, 200, 032	877, 611	1, 098, 718
Prepared or preserved—										
Canned	....	603, 288	....	528, 914	....	560, 612	....	597, 759	....	719, 580
Other	....	496, 542	....	544, 764	....	667, 761	....	745, 697	....	785, 076
Total prepared or preserved	....	1, 099, 830	....	1, 073, 678	....	1, 228, 373	....	1, 343, 456	....	1, 504, 656
Total vegetables..........	....	2, 853, 278	....	2, 598, 417	....	2, 546, 287	....	2, 543, 488	....	2, 603, 374
Vinegar ....gallons..	115, 372	12, 583	83, 780	13, 231	95, 675	19, 754	103, 417	18, 072	132, 450	19, 192
Wines. (*See* Liquors, alcoholic.)										
Yeast	....	8, 086	....	6, 809	....	8, 439	....	24, 675	....	18, 772
Total vegetable matter, including forest products.....	....	662, 053, 451	....	750, 580, 770	....	655, 226, 446	....	715, 763, 322	....	556, 040, 266
Total vegetable matter, excluding forest products.....	....	609, 376, 876	....	695, 211, 609	....	606, 297, 682	....	657, 482, 349	....	626, 126, 055
Total agricultural exports, including forest products...	....	897, 293, 105	....	1,006,997,492	....	906, 042, 297	....	936, 760, 575	....	929, 246, 053
Total agricultural exports, excluding forest products...	....	844, 616, 530	....	951, 628, 331	....	857, 113, 533	....	878, 480, 557	....	859, 160, 264

VALUES OF FOREIGN COINS AND CURRENCIES.

[As given by the Director of the United States Mint and published by the Secretary of the Treasury.]

COUNTRIES WITH FIXED CURRENCIES.

Countries.	Standard.	Monetary unit.	Value in U.S. gold.	Coins.
Argentine Republic	Gold and silver	Peso	$0.96,5	Gold—argentine ($4.82,4) and ½ argentine; silver—peso and divisions.
Austria-Hungary	Gold	Crown	.20,3	Gold—20 crowns ($4.05,2) and 10 crowns.
Belgium	Gold and silver	Franc	.19,3	Gold—10 and 20 francs; silver—5 francs.
Brazil	Gold	Milreis	.54,6	Gold—5, 10, and 20 milreis; silver—½, 1, and 2 milreis.
British N. A. (except Newfoundland).	do	Dollar	1.00	
British Honduras	do	do	1.00	
Chile	do	Peso	.36,5	Gold—escudo ($1.25), doubloon ($3.65), and condor ($7.30); silver—peso and divisions.
Colombia	do	Dollar	1.00	Gold—condor ($9.647) and double condor; silver—peso.
Costa Rica	do	Colon	.46,5	Gold—2, 5, 10, and 20 colons; silver—5,10,25, and 50 centisimos.
Cuba	Gold and silver	Peso	.91	Gold—doubloon ($5.01,7); silver—peso (60 cents).
Denmark	Gold	Crown	.26,8	Gold—10 and 20 crowns.
Ecuador	do	Sucre	.48,7	Gold—10 sucres ($4.8665); silver—sucre and divisions.
Egypt	do	Pound (100 piasters).	4.94,3	Gold—10, 20, 50, and 100 piasters; silver—1, 2, 10, and 20 piasters.
Finland	do	Mark	.19,3	Gold—10 and 20 marks ($1.93 and $3.85,9).
France	Gold and silver	Franc	.19,3	Gold—5, 10, 20, 50, and 100 francs; silver—5 francs.
Germany	Gold	Mark	.23,8	Gold—5, 10, and 20 marks.
Great Britain	do	Pound sterling	4.86,6½	Gold—sovereign (pound sterling) and half sovereign.
Greece	Gold and silver	Drachma	.19,3	Gold—5, 10, 20, 50, and 100 drachmas; silver—5 drachmas.
Haiti	do	Gourde	.96,5	Silver—gourde.
India	Gold	Rupee	.32,4	Gold—sovereign ($4.8665); silver—rupee and divisions.
Italy	Gold and silver	Lira	.19,3	Gold—5, 10, 20, 50, and 100 lire; silver—5 lire.
Japan	Gold	Yen	.49,8	Gold—1, 2, 5, 10, and 20 yen.
Liberia	do	Dollar	1.00	
Netherlands	Gold and silver	Florin	.40,2	Gold—10 florins; silver—½, 1, and 2½ florins.
Newfoundland	Gold	Dollar	1.01,4	Gold—$2 ($2.02,7).
Peru	do	Sol	.48,7	Gold—libra ($4.8665); silver—sol and divisions.
Portugal	do	Milreis	1.08	Gold—1, 2, 5, and 10 milreis.
Russia	do	Ruble	.51,5	Gold—imperial ($7.718) and ½ imperial ($3.80); silver—¼, ½, and 1 ruble.
Spain	Gold and silver	Peseta	.19,3	Gold—25 pesetas; silver—5 pesetas.
Sweden and Norway	Gold	Crown	.26,8	Gold—10 and 20 crowns.
Switzerland	Gold and silver	Franc	.19,3	Gold—5, 10, 20, 50, and 100 francs; silver—5 francs.
Turkey	Gold	Piaster	.04,4	Gold—25, 50, 100, 200, and 500 piasters.
Uruguay	do	Peso	1.03,4	Gold—peso; silver—peso and divisions.
Venezuela	Gold and silver	Bolivar	.19,3	Gold—5, 10, 20, 50, and 100 bolivars; silver—5 bolivars.

COUNTRIES WITH FLUCTUATING CURRENCIES.

Country and monetary unit.	Apr. 1, 1904.	July 1, 1904.	Oct. 1, 1904.	Jan. 1, 1905.	Country and monetary unit.	Apr. 1, 1904.	July 1, 1904.	Oct. 1, 1904.	Jan. 1, 1905.
Bolivia:	*Cts.*	*Cts.*	*Cts.*	*Cts.*	China—Continued.	*Cts.*	*Cts.*	*Cts.*	*Cts.*
Silver boliviano	41.9	40.3	42.2	43.1	Niuchwang tael	64.4	62	64.8	66.3
Central America:					Peking tael	67	64.4	67.4	68.9
Silver peso	41.9	40.3	40.3	43.1	Shanghai tael	62.7	60.3	63.1	64.5
China:					Tientsin tael	66.6	64	67	68.5
Canton tael	68.5	65.9	68.9	70.5	Mexico:				
Chifu tael	65.7	63.2	63.1	67.6	Silver dollar[a]	45.5	43.8	45.8	46.8
Fuchau tael	63.5	61.1	63.9	65.4	Persia:				
Haikwan tael	69.9	67.2	70.3	71.9	Silver kran	7.7	7.4	7.8	7.9

[a] The Mexican dollar is to have in Mexico after May 1, 1905, a fixed value of 49.8 cents.

INDEX.

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Date of issue.	Date of issue.	Date of issue.